The Journal of the American Medical Association

Published Under the Auspices of the Board of Trustees

VOL. LIX, No. 12.—PART 2 CHICAGO, ILLINOIS SEPTEMBER 21, 1912

SECTION ON OPHTHALMOLOGY

PAPERS† AND DISCUSSIONS

SYMPATHETIC CHORIOIDITIS*

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Since the immortal Koch first succeeded in proving to a doubting medical world the microbic origin of disease, and since we have learned more and more of the manner in which microbes gain entrance primarily or secondarily into a wound and how, having once entered, they may invade the whole body, the search for the specific microbic irritant in such diseases in which it has as yet not been found is continuously going on.

This is also the case with sympathetic inflammation, and quite naturally so. In the vast majority of these cases, of which after all even a very busy man sees not very many in a life-time, the affection begins with a wound, whether accidental or operative, in the one eye, which causes this eye to become more or less severely inflamed. Usually only a few weeks later the fellow eye also becomes the seat of an inflammation, which in the great majority of cases leads to its destruction. What more natural, therefore, than to assume that the inflammatory process in the first affected eye is due to a microbic infection, which has taken place when the wound was received, or secondarily, and that the resulting inflammation, or perhaps its cause itself, travels gradually over to the fellow eye? What more simple than to assume that the way by which this migration takes place is the preformed way of the optic nerve and intervaginal space, around in front of the chiasma and down the nerve and the intervaginal space to the fellow eye?

That such a transition of noxious substances and microbes from one eye to the other is possible has, it seems, long ago been proved experimentally by R. Deutschmann, H. Gifford, myself and others. Most recently such experiments with most brilliant results have been made and published[1] by F. Deutschmann, who also found that the anterior half of the chiasma showed signs of inflammation and thus supplied a link in the chain which has been hitherto wanting. After such definite results this possibility surely cannot be doubted by any one. Unfortunately, however, but few observers have apparently been able to demonstrate, at least to their own satisfaction, the offending microbes in the injured eye even. The majority were unable to find any. Even in his now celebrated series of eyes with sympathizing inflammation, from which Fuchs evolved a picture which he considers an absolutely separate one and characteristic of this form of inflammation, quite distinct from that of a septic endophthalmitis, he did not find any microbes. In a number of cases, which I have studied most diligently, I have been no more fortunate. Still, I doubt whether our present inability in this direction should force us to assume that the unknown specific microbe of sympathetic inflammation circulates in the blood and comes into activity in the eye only after an injury has been received, or to assume that, at the time when the first affected eye is removed and subjected to microscopic examination, the infecting microbes have been destroyed by the activities of the tissues of the eye, and, perhaps, their toxins only have kept up the inflammation. Yet, after all, whatever theory we assume—and you know there are others not mentioned here—especial and exceptional conditions must prevail in all such cases, or sympathetic ophthalmia would be a much more common disease.

There are other puzzling questions. Why should sympathetic ophthalmia sometimes appear years after the original wound has been received—sometimes many years afterward? Schirmer thinks that the greater the interval between the affections of the two eyes, the less probability of a correct diagnosis. Yet observers whose judgment can hardly be doubted have described such late cases. We know that there are microbes which may, so to speak, remain dormant or inactive in the human body for years and then be again aroused to activity. A similar condition might account for such late cases of sympathetic inflammation. Why does sympathetic inflammation appear in a variety of forms? In a general way, of course, we know that it involves preeminently the uveal tract, but, it seems, it will not do to look on the different pictures under which sympathetic inflammation appears as simple gradations of one and the same uveal affection. Whoever has seen and studied a case of sympathetic optic neuritis—and we shall hear something about such cases at this meeting—or a case of so-called sympathetic chorioiditis, must surely come to the conclusion that these are special and distinct forms of sympathetic inflammation.

* Chairman's address.

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.

† As the footnotes indicate, certain papers are here printed in abbreviated form.

1. Deutschmann, F.: Arch. f. Ophth. (von Graefe's), 1911, lxxviii, 494.

Why does the removal of the first affected eye apparently have a beneficial influence on the course of an already well-established—that is, macroscopically recognizable—sympathetic inflammation? Elschnig says it has no such influence; yet how can we doubt it, when we see an eye saved after enucleation of its injured fellow, which, had we waited longer before performing this operation, according to our experience and observation, would in all probability have been lost?

While, then, to a great many of us, although no specific microbe has been as yet demonstrated, a microbic origin seems still to be the most probable explanation of this peculiar inflammation. Elschnig has lately attempted another one, which has in it much that is enticing and is certainly worthy of careful study. In assuming that sympathetic inflammation is an anaphylactic uveitis due to the absorption of disintegrated uveal tissue in the injured eye, and that both sympathizing and sympathetic inflammation are due to the anaphylactic reaction of a thus oversensitized uveal tissue to an anomalous condition in the organism, Elschnig has directed the theorizing about sympathetic inflammation into a new direction. Perhaps, his may prove to be the right conception. Yet, like all theories, that of Elschnig has its weaknesses, and they have already been pointed out by Reis.[2]

It seems, then, that there is still room for much study in this chapter of ophthalmology and still a chance for a glorious achievement and a laurel wreath for the one who some day shall solve this riddle. To accept such a possibility it is only necessary to remember how often the malaria germ was apparently found and denied, and more recently how many organisms have been demonstrated as the contagium of syphilis, before Schaudinn succeeded in proving that the *Spirochæta pallida* was the real one, and I still hope for a similar solution of the cause of sympathetic inflammation.

After these rambling remarks, permit me now to relate to you a case of sympathetic chorioiditis, a form of sympathetic inflammation, which, according to literature, has not as yet been observed very often. Schirmer, in the second edition of Graefe-Saemisch, mentions only Colsmann, Rothmund and Eversbusch, Dolschenko, Leplat and himself as having described characteristic cases of sympathetic chorioiditis without a previous sympathetic iridocyclitis. He states, further on, that, after or contemporaneous with a sympathetic iridocyclitis, chorioiditic changes have been observed by Graefe, Haab and Hirschberg. A beautiful illustration of a case of sympathetic chorioiditis made by Haab accompanies Schirmer's work. The following case is the first of this kind of sympathetic inflammation which I have been in a position to observe:

Patient.—E. R., aged 9, a thin boy, who, however, showed no specific dyscrasia, was brought to my office on Nov. 5, 1911, his left eye having been injured, probably by a playmate on November 1. He has never given an explanation of how the injury came about, but his family think that the offending instrument was the end of a dirty whip.

Examination.—When I first saw him there was some chemosis and ciliary injection of the injured eye, yet the pupil was fairly large, but slightly displaced toward a wound about 3 mm. in length, which was situated exactly in the corneoscleral margin of the inner upper quadrant. The wound had penetrated the corneoscleral tissue and the iris at its very periphery and was plugged by a small amount of vitreous body. The iris periphery was also caught in it and some pus could be seen lying just in front of the apex of the ciliary body. The lens was perfectly opaque, rendering an ophthalmoscopic examination impossible. Vision was *nil.*

Treatment and Course.—In spite of a careful cleansing of the wound, the application of the necessary local treatment and the immediate internal administration of mercury and aspirin, the inflammatory symptoms increased for some time. a small hypopyon made its appearance and the pupil gradually became much smaller. Yet the boy never acknowledged suffering any pain whatever. An *x*-ray examination showed no foreign body within the eye.

Gradually the inflammatory symptoms receded, although the pupil was finally closed up altogether, and the eye became somewhat softer. December 5 the patient had distinct light perception, and I almost dared hope that it might be possible to give this eye some sight by operative measures.

During this whole period of time the fellow eye was, of course, watched anxiously and most carefully, but never showed the slightest sign of irritation.

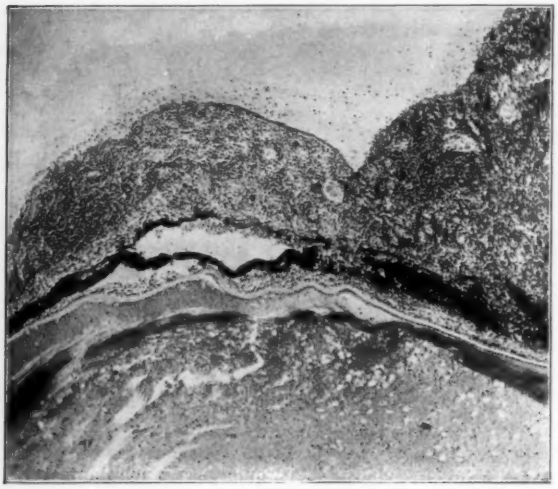

Fig. 2.—Iris thickly infiltrated with lymphocytes. Hemorrhagic space severing the posterior layers. Lens capsule wrinkled. Traumatic cataract.

Fig. 3.—Above, ciliary body filled with lymphocytes. Paler parts epithelioid cells. Below, cyclitic membrane. Non-pigmented epithelium of ciliary body pressed inward in the shape of blebs.

2. Reis: Arch. f. Ophth. (von Graefe's), 1911, lxxx, 69.

Now, the patient, in spite of the earnest warnings given to his parents, disappeared from observation and did not return till Jan. 11, 1912, with the statement that he was well and had neither had drops put into the eye nor taken any medicine internally for three weeks. And it proved to be fortunate that he returned just then. For, as soon as he sat down before me, I noticed a flushing of the episcleral vessels in the good eye and saw, also, that the pupil was contracted. It hardly reacted to light. Atropin solution, immediately instilled, produced its dilatation *ad maximum* so promptly that I thought that no iritis could as yet have developed. Yet, a broken circle of minute brownish pigment deposits corresponding with the size of the pupil could be demonstrated on the anterior lens capsule, both by oblique illumination and the ophthalmoscope. There was, also, a fine, dust-like opacity of the posterior parts of the vitreous body, the papilla was reddish, its outlines were veiled here and there and the retinal veins were somewhat tortuous. I do not think there can be any doubt but that this eye was just beginning to be attacked by sympathetic inflammation.

In spite of an urgent message to him the father brought the boy back to me only two days later. He at first refused to believe in the urgency of removing what he thought now was a healthy eye, but finally yielded to my entreaties. For external reasons I had the boy taken to the Free Children's Hospital, where Dr. W. F. Hardy was kind enough to enucleate the left eye the same evening (January 13) and to undertake

Fig. 4.—Anterior part of ciliary body infiltrated with lymphocytes and epithelioid cells; the latter have broken through the lamina vitrea in several places. Near the middle part to the right, several giant cells.

the further treatment. Dr. Hardy gave the following short further history of the case:

"The patient was kept in the hospital for the six weeks following operation for treatment and observation.

"When he entered the hospital the right eye showed the following conditions: slight episcleral injection; pupil *ad maximum* dilated; numerous minute pigment dots arranged in a circle on the anterior lens capsule, evidently remnants of a slight iritis. The vitreous body was somewhat cloudy and the outlines of the disk were indistinct. The retinal vessels were tortuous.

"The treatment consisted in keeping the pupil widely dilated, daily mercurial inunctions and aspirin (30 grains) internally. Under this treatment a gradual improvement took place. The pigment spots on the lens capsule disappeared, the outlines of the disk became more and more distinct and the vitreous body cleared up. At the end of two months the conditions of this eye were apparently again normal.

"At this time Dr. Alt, who saw the case with me every Sunday, detected a number of chorioidal spots in the inferior equatorial region, the remainder of the fundus being free from them.

"Up to this date (May 5) the treatment has been but slightly relaxed and the eye now appears normal, except for the chorioidal spots, a slight redness of the papilla and a slight tortuosity of the retinal veins.

"His V = 20/15 with a + 1.75 D. lens; he wears an artificial eye with great comfort."

I wish to describe a little more in detail what I know about the chorioidal spots. In the first place, I had carefully examined the eye with the ophthalmoscope on March 12, when there was nothing pathologic to be detected in the chorioid, but one week later, on March 19, I found the chorioidal spots. They, therefore, had put in appearance some time between these two dates. That means that the chorioiditis developed about four and one-half months after the injury to the first affected eye and a little over two months after the onset of the sympathetic inflammation, and, furthermore, at a time when all other symptoms, except a slight redness of the papilla and a slight tortuosity of the retinal veins, had disappeared.

When I first saw these spots, I counted seven of them. They differed in size and appearance, but were striking

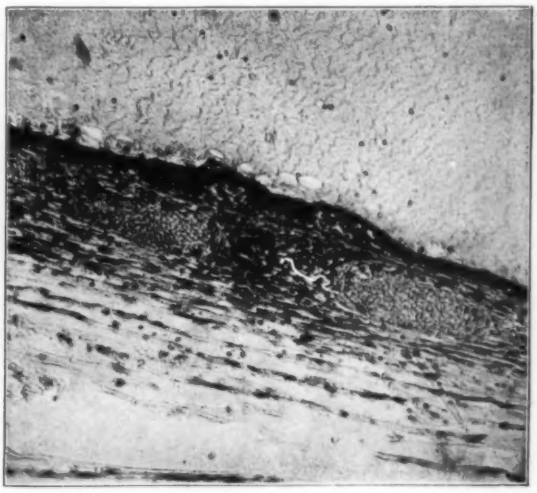

Fig. 6.—Anterior part chorioid. Small nests of epithelioid cells forming on the lamina vitrea, derived from the pigment epithelial cells. Lymphocytic infiltration.

in the uniform round and sharp outline, as if they were cut out with a punch. The two largest ones were about the size of a fifth of the disk diameter; the smallest ones were minute dots. The larger ones had an ivory color; the smaller ones were more yellow and the smallest ones had a bright golden, shining appearance, which somewhat resembled that of colloid excrescences of the chorioid, but was perhaps more brilliant. During the following week some new spots of the same sharp round outline made their appearance. One of the ivory-colored larger spots showed a central pigment spot. Near this one a large hemorrhagic effusion sometime later appeared in the chorioid, which was oval in shape and a little larger than the disk. Gradually the larger spots assumed a more pinkish tint and some slight pigment disturbances were visible at their edges. At this date, some of the spots have altogether disappeared, but some of the smallest ones still shine with their peculiar luster.

We have, then, in this case, one of the few hitherto observed cases of characteristic sympathetic chorioiditis

without a previous cyclitis, though preceded by a neuritis, and by an iritis which was of the mildest type, and which never interfered with an ophthalmoscopic examination in the least.

The microscopic examination of the enucleated injured eyeball proved to be as interesting as was the clinical observation.

When I cut the eyeball equatorially in two, the slightly yellow fluid vitreous body ran out. Of this I made a number of specimens, which I stained after different methods for bacteria. However, I found none. There were only a few leukocytes and lymphocytes in the fluid.

From the site of the healed wound a band of tissue could be traced entering the eyeball between the iris periphery and the ciliary body and joining a cyclitic membrane behind the shrunken and cataractous lens. The anterior surface of the lens was covered throughout by the swollen iris. The anterior chamber was deep and a small amount of hardened exudate adhered to its walls. The ciliary body, as usual, was merged everywhere into the cyclitic membrane. There were a number of hemorrhages in the retina without any special arrangement. The most peculiar picture, however, was that of the papilla and the macular region. The papilla could barely be recognized as such, although it protruded somewhat into the eye, since its surface was perfectly flat. From its temporal side a large transparent vesicle was seen to start, which reached beyond the macula lutea. Its anterior wall floated about and it contained some blood. At first this impressed me as a detached part of the retina, but when studying it with an electric lamp I found that the retina could be seen forming the bottom of the vesicle.

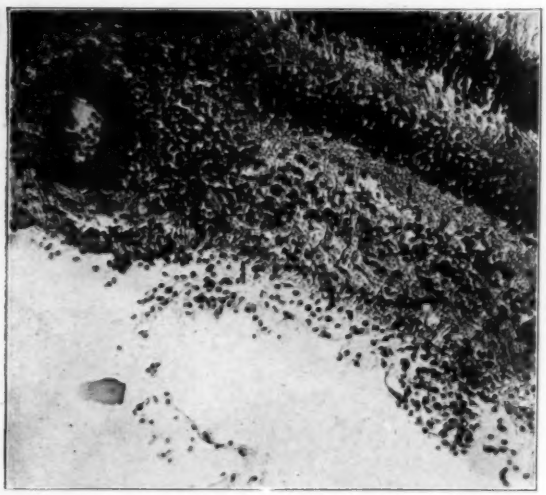

Fig. 9.—Lymphocytic infiltration of retina especially around a blood-vessel. Limitans interna detached in small folds by lymphocytes and small hemorrhages.

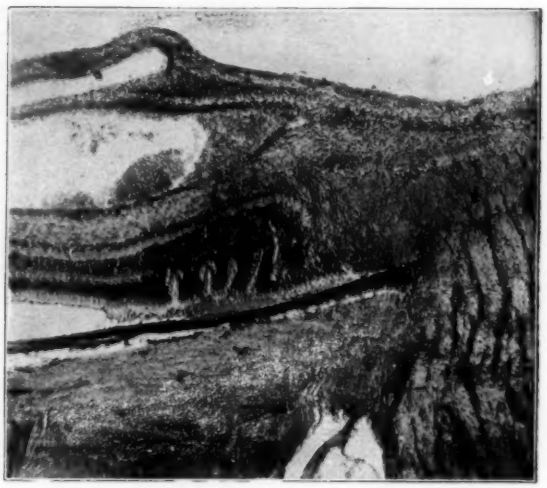

Fig. 10. Optic nerve and papilla. Lymphocytic infiltration and edema. Newly formed connective tissue covers papilla and retina and is lifted up, on left, by hemorrhage.

The following are the results of the microscopic examination:

Microscopic Examination.—The band of tissue which reaches inward from the site of the wound is solid connective tissue, which has replaced the vitreous body originally lying there. It fills the former gap and joins the cyclitic membrane. There are few blood-vessels in this tissue. In the episcleral and subconjunctival tissue there are a few foci of infiltration with lymphocytes (Fig. 1).

The iris tissue is very densely infiltrated with lymphocytes. In a general way this infiltration is densest in the posterior parts, yet there are here and there places in which these cells lie so close to each other that no space seems to be left between them. In the sections taken from the neighborhood of the pupil only a few transverse sections of the filled blood-vessels are found near the anterior iris surface, while in sections from the iris periphery a great many are still visible. Between the lymphocytes numerous plasma cells and erythrophils are found. Near the pupillary edge of the iris the pigment layer on the back of the iris has become detached, so as to form a cyst-like opening, which suggests the possibility of an artefact. As this space, however, contains quite a quantity of blood, it was probably formed before the enucleation by a hemorrhage. It may have been aided in its formation by the contraction of a small amount of newly formed connective tissue, which agglutinates the posterior iris surface to the wrinkled anterior lens capsule (Fig. 2).

The anterior surface of the iris, as well as the posterior surface of the cornea, is covered with a small amount of exudation in which some leukocytes, lymphocytes and plasma cells are suspended.

Evidently the injuring foreign body had ruptured the posterior lens capsule. In consequence the capsule is folded and wrinkled and the lens tissue, especially its posterior part, not only is undergoing cataractous degeneration, but also is pervaded by innumerable leukocytes and lymphocytes and has been partly dissolved. In spite of such great changes the capsular epithelium appears almost unaltered.

The ciliary body, in its anterior portion, is changed into a mass of lymphocytes, between which no muscular or connective tissue can be found. Here and there are nests of epithelioid cells, and numerous giant cells. The muscular fibers become visible backwards near the pars plana only and are here widely separated by a blood-stained serofibrinous exudate, which reaches back between chorioid and sclerotic to the optic papilla, spreading the endothelial layers of the suprachorioid in places widely apart. The cells of the pigmented retinal layer of the ciliary body are dragged inward by the cyclitic membrane, as we see often. The cells of the unpigmented retinal layer are not only here and there separated from the pigmented ones by intervening infiltration, but in places are lifted off *in toto*, so that cysts of considerable size are formed between the two layers, which contain remains of former hemorrhage and some lymphocytes; some are even

still filled with blood. The cyclitic membrane, which completely shuts off the anterior third, is still very rich in cells and blood-vessels (Fig. 3).

In the posterior part of the ciliary body and the anterior part of the choroid, epithelioid cells are frequent, and they form the now well-known, less-stained islets between the deeper-stained lymphocytes. In numerous places they have broken through the lamina vitrea and grown through the retinal layers into the new-formed cyclitic tissue (Fig 4). There are, also, numerous little nodules of epithelioid cells here and there lying on the lamina vitrea, lifting up the partly disintegrated pigment epithelium cells from which they are probably derived (Dalén, Fuchs—Fig. 5).

The tissue of the cyclitic membrane has pulled the periphery of the retina forward to a different degree in different sections, yet more so near the original wound than elsewhere. The folded retina in these parts is attached to the pars plana of the ciliary body by intervening newly-formed tissue. There are here and there hemorrhages, separating these folds from each other or from the tissue outside of them. On the inner side the folds are covered with a few layers of newly-formed connective tissue in such a manner that their surface is rendered smooth (Fig. 6).

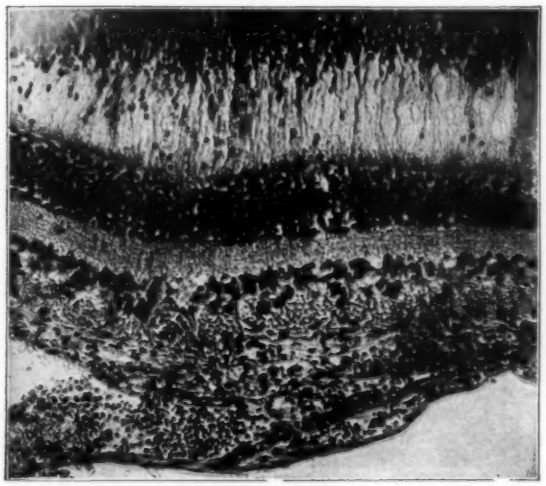

Fig. 12.—Retina at temporal side of large vesicle where limitans interna and newly formed connective tissue join the retina. Lymphocytic infiltration. Blood in angle between retina and vesicle wall (left side). External molecular layer almost gone. In upper right-hand corner a hemorrhage between the nuclear layers.

The anterior part of the choroid shows, next to the iris and ciliary body, the most intense infiltration with lymphocytes. This infiltration in places is thickest around the large blood-vessels, but frequently the whole thickness of the choroid is densely packed with lymphocytes. The visible blood-vessels are gorged with blood. An irruption of lymphocytes into the blood-vessels, such as Fuchs has described, I have not been able to find (Fig. 7).

Toward the equator the lymphocytic infiltration of the choroid diminishes gradually and then ends rather abruptly. The posterior parts of the choroid show hardly any infiltration, but are hyperemic and contain a serofibrinous exudate.

The blood-vessels and nerves which penetrate the sclerotic back of the equator and at the posterior pole are accompanied by very few lymphocytes and not surrounded by a thick infiltration, such as Fuchs described. Neither have the lymphocytes broken through the sclerotic in any place.

Contrary, also, to Fuchs' observation, in the eye here described, the retina is highly affected, almost throughout. In the least affected portions there is only a lymphocytic infiltration around the blood-vessels (Fig. 8). In others the lymphocytes pervade especially the nerve-fiber and inner molecular layer. In the more peripheral parts the nerve-fibers have almost altogether disappeared and their layer is represented mainly by the supporting fibers of Mueller, between which numerous lymphocytes are lying. The ganglion cells are undergoing degeneration or have disappeared altogether. In numerous sections, especially of the posterior parts of the retina, sometimes the inner, sometimes the outer molecular layer is wanting, and there are evidences of former edema. The rods and cones, however, are, as a whole, strangely well preserved, only, where an exudation or hemorrhage has pressed against them, they are degenerated to a varying degree.

Almost the whole inner surface of the retina is covered with a thin, newly-formed membrane. In many places, by shrinking, hemorrhages or infiltration this newly-formed membrane is detached from the retina together with the inner limiting membrane (Fig. 9). In some places, and especially where a large area has become thus detached, this seems to have been due to a hemorrhage, as blood-cells and lymphocytes are found in the now apparently empty vesicle-like spaces. The largest one of these vesicles starts from the edematous temporal edge of the papilla and reaches uninterruptedly to beyond the macular region (Figs. 10 and 14). The continuation of the newly-formed membrane on the nasal side of the papilla is

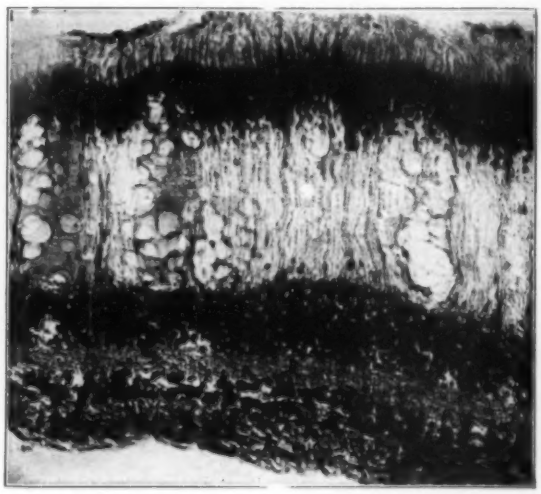

Fig. 13.—Retina from temporal side of large vesicle. Some lymphocytic infiltration. Numerous hemorrhages between the nuclear layers.

but slightly separated from the retina. The large vesicle lying over the macula still contains a considerable amount of blood, although during the staining process most of it has fallen out (Fig. 11). The macular region itself is strangely free from pathologic conditions, but somewhat to the temporal side of it a number of hemorrhages of an elongated shape lie between the nuclear layers, arranged in the manner in which we usually find the fibrinous exudation in albuminuric retinitis (Figs. 12 and 13).

The optic papilla is edematous and swollen, especially on its temporal side. It is pushed far enough into the interior of the eye to cause the neighboring retina to be thrown into numerous folds. Its central blood-vessels are in parts surrounded by large quantities of lymphocytes, as far back as the nerve reaches. Similar foci of lymphocytic infiltration are found here and there in the arachnoid and pia mater sheath (Figs. 14 and 15).

The inner surface of the papilla is covered with the newly formed membrane, which also covers the inner surface of the retina and forms the vesicle over the macula, described above. There are numerous blood-vessels within the newly-formed tissue. At the temporal side of the papilla a club-shaped process containing blood-vessels has grown toward th. interior

of the eye, and in some sections a number of very thin membranous excrescences accompany it. This condition is apt to remind one of a persistent hyaloid artery. Yet, it is impossible to find any connection between this appendix and the central retinal blood-vessels in the papilla. It probably owes its origin to former hemorrhages and is similar in nature to what Manz termed proliferating retinitis.

No microbes could be found in the tissues of the eye.

From this description it is seen that the pathologic conditions in this eye, which undoubtedly caused a sym-

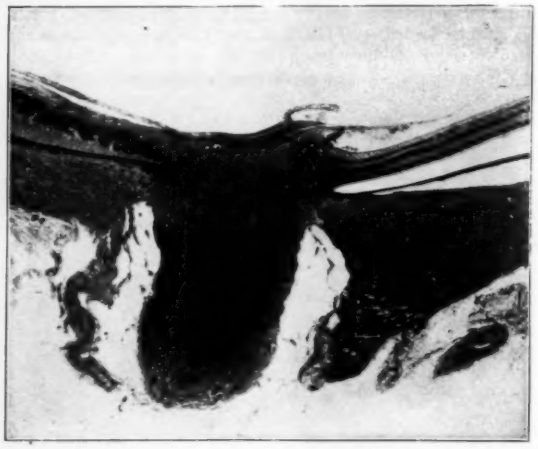

Fig. 14.—Optic nerve and papilla. Infiltration and edema. Newly formed connective tissue covers retina and papilla and is detached, together with the limitans interna on the right, by hemorrhage, forming the large vesicle reaching beyond the macular region. From this newly formed tissue a teatlike process has grown into the vitreous chamber.

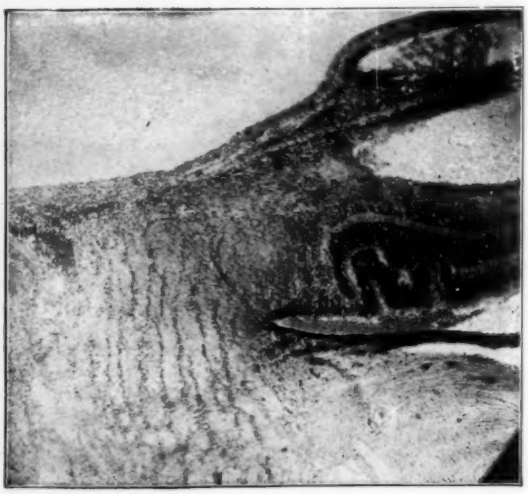

Fig. 15.—Optic nerve-head. Edema by lymphocytic infiltration, especially around the central blood-vessels. Retina thrown into folds by edema. Newly formed connective tissue covering the papilla.

pathetic inflammation of the fellow eye, while showing much which Fuchs considers as essentially characteristic of the sympathizing inflammation, differ in other points very materially from his description. While he states that the retina and optic nerve are usually but slightly affected, in this eye—aside from the considerable inflammation in the anterior parts near the wound which affects all the tissues—the severest inflammatory signs, either still actively present or shown by their results, are found in the retina, and especially in the posterior parts, where the chorioid is but little affected, quite contrary to the usual experience.

The character of the sympathizing inflammation in this case seems to have been preeminently a hemorrhagic and proliferating one. From this it seems that Fuchs laid out the limits of the range of what may be called a sympathizing inflammation somewhat too narrowly.

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SCLEROSIS OF THE LIGAMENTUM PECTINATUM AND ITS RELATION TO GLAUCOMA *

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In the pathologic examination of glaucomatous eyes I have several times noted a condition that seemed of considerable significance in regard to the pathogenesis of glaucoma, namely, sclerosis of the ligamentum pectinatum with an open filtration angle. The condition, I find, has been previously described by a few other observers, all of whom have evidently regarded it as the cause of the advanced glaucoma with which it was associated. Brief mention is made of it by Schmidt-Rimpler,[1] and single cases have been recorded by Tartuferi,[2] Sarti[3] and De Vries.[4] The latter explained the sclerosis as due to toxins carried in the aqueous humor, an explanation which suggests that we have here a form of glaucoma dependent on the same cause as arteriosclerosis.

Thomas Henderson,[5] in his theory of glaucoma, which, as I understand it, is a variation of the old retention theory, postulates a sclerosis of the ligamentum pectinatum. He maintains that with age the trabeculæ of the ligament become thicker so that finally in some cases glaucoma ensues, owing to the cutting off of the access of aqueous humor to the canal of Schlemm and the consequent rise of intra-ocular venous pressure. At the same time, as a result of congestive edema, the iris swells, causing its root to become adherent to the ligamentum pectinatum. The actual existence of this advanced sclerosis, however, he has not demonstrated, no doubt because at the stage when glaucomatous eyes are usually obtained for histologic examination, adhesion of the iris root had been of such long standing that it was impossible to determine whether the sclerosis of the ligament was the cause or the result of the adhesion. It is true that in the few recorded cases in which glaucomatous eyes were examined at very early stages sclerosis of the ligament was not noted, but it is possible that they were not examined with special reference to this point.

It is obvious, therefore, that if it could be shown that cases of glaucoma occur in which there is primary sclerosis of the ligamentum pectinatum with the filtration angle partly or wholly open, Henderson's theory would receive strong support, since it would not be

* From the Massachusetts Charitable Eye and Ear Infirmary.

1. Schmidt-Rimpler: Graefe-Saemisch Handbuch der Gesamten Augenheilkunde, 1908, ii, 104.
2. Tartuferi: Cited by Sarti, note 3.
3. Sarti: Bull. d. Soc. med.-chir. di Bologna, 1882, lxiv, 147; Centralbl. f. Augenheilk., 1895, p. 488.
4. De Vries: Nederl. Tijdschr. v. Geneesk., 1907, ii, 263; Nagel's Jahresbericht, 1908, p. 680.
5. Henderson: Glaucoma, London, 1910.

expected that the assumed edema of the iris would always be sufficient to cause peripheral synechia. Even if Henderson's theory was not accepted in its entirety — and his argument does not seem altogether convincing — sclerosis of the ligament would no doubt be accepted as an essential cause of glaucoma. The evidence, however, that I have to bring forward, seems to point in an opposite direction, so that sclerosis of the ligamentum pectinatum as a cause of glaucoma yet remains to be demonstrated.

Following are brief summaries of the findings in ten cases in which there was sclerosis of the ligamentum pectinatum with an open filtration angle:

CASE 1 (2-1780).—*Clinical History.*—The patient, a man aged 38, was struck in the left eye while boxing twenty years ago. Cataract resulted, which was removed by discissions thirteen years ago. Nine years ago he was again struck in the left eye with a fist. After this the patient could see but little, and the eye was painful at times. Eighteen months ago paracentesis for acute glaucomatous attack was performed. The right eye was normal. The left eye was enucleated Dec. 18, 1909.

Pathologic Condition.—There were advanced secondary glaucoma following discission of the lens, with prolapse of the vitreous into the corneal incision, equatorial staphyloma, deep cupping of the optic disk and advanced atrophy of the retina, iris and ciliary body. The pupil was free; the filtration angle was everywhere open. The ligamentum pectinatum was covered with fibrous membrane continuous with the anterior boundary layer of the iris. The spaces of Fontana and the canal of Schlemm were obliterated.

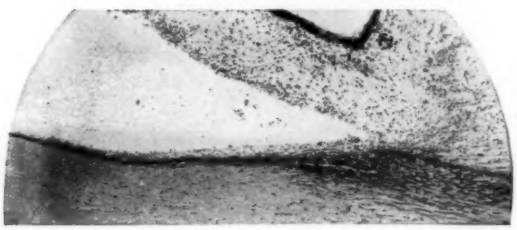

Fig. 1.—Case 7. Primary glaucoma. Hyaline fibrous tissue extending over surface of ligamentum pectinatum and membrane of Descemet. The underlying trabeculæ are still well seen.

CASE 2 (2-891).—*Clinical History.*—The patient, a man aged 32, had an old injury of the left eye with traumatic cataract. Ten years ago the cataract was extracted, after which there was much pain. The tension was + 3. The right eye was normal. The left eye was enucleated May 25, 1904.

Pathologic Condition.—There were advanced secondary glaucoma, old perforation of the cornea, traumatic cataract, ciliary staphyloma, deep cupping of the optic disk, advanced atrophy of the retina and atrophy of the ciliary body, marked at the site of the staphyloma, but slight elsewhere. The pupil was free; the iris was almost normal, except at the pupillary margin, where there was beginning ectropion. The filtration angle was everywhere open. The ligamentum pectinatum was covered with a smooth layer of hyaline tissue, which was lined by flattened pigmented cells. The trabeculæ were visible, but the spaces of Fontana and the canal of Schlemm were obliterated (Fig. 3).

CASE 3 (2-2097).—*Clinical History.*—The patient, a man aged 73, twenty-seven years ago was struck in the right eye with a chip from a hammer. The eye soon afterward became blind and has since been very irritable at times. The tension was + 1. The left eye was normal. The right eye was enucleated Nov. 10, 1911.

Pathologic Condition.—There were advanced secondary glaucoma, an old perforating wound of the cornea and lens, a small foreign body encysted on the posterior part of the ciliary body, slight siderosis bulbi, localized chorioretinitis in the lower outer quadrant (due to movement of foreign body before it became encysted?), deep cupping of the optic disk and moderate atrophy of the retina. The pupil was free, partly excluded. The iris and ciliary body were almost free from atrophy, but showed slight recent iridocyclitis. The filtration angle was everywhere open. The ligamentum pectinatum was in places almost free from sclerosis. In these places the stroma cells of the ligament were greatly pigmented (pigment bleaches, hence not iron pigment) and the spaces of Fontana contained chronic inflammatory cells. Elsewhere, and to some extent also here, the ligament was covered with a thin hyaline layer lined by pigmented cells continuous around the angle with the anterior boundary layer of the iris. The underlying trabeculæ and spaces of Fontana were almost normal.

CASE 4 (2-557).—*Clinical History.*—The patient, a man aged 48, was struck in the right eye with a piece of steel twenty-two years ago; the left eye was normal. The right eye was enucleated May 1, 1901.

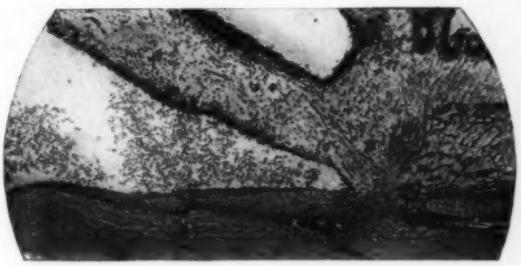

Fig. 2.—Case 7. Primary glaucoma. Dense hyaline fibrous tissue on surface of ligamentum pectinatum. The underlying trabeculæ are greatly compressed so that the new tissue might readily be mistaken for the ligament itself.

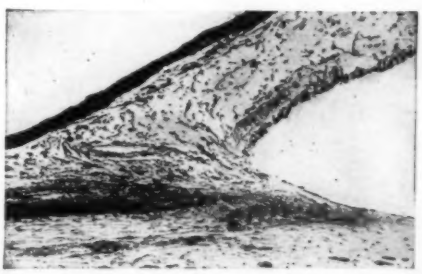

Fig. 3.—Case 2. Secondary glaucoma. Ligamentum pectinatum covered with a smooth layer of hyaline tissue lined by flattened pigmented cells. The almost complete absence of iris atrophy indicates that the separation of the peripheral synechia occurred early. The atrophy of the ciliary body here is due to a ciliary staphyloma.

Pathologic Condition.—There were advanced secondary glaucoma, traumatic cataract, equatorial staphyloma, foreign body in the vitreous chamber, slight siderosis bulbi, deep cupping of the optic disk and advanced atrophy of the retina, iris and ciliary body. The pupil was free. The filtration angle was mostly open, being closed only along a small part of the circumference. The ligamentum pectinatum was covered with a thin dense hyaline layer presenting a smooth surface lined by endothelium. The spaces of Fontana and the canal of Schlemm were obliterated.

CASE 5 (2-2057).—*Clinical History.*—The patient, a man aged 53, received a perforating wound of the corneal limbus of the left eye thirty-four years ago. The foreign body was retained in the globe. Four years ago the patient was told that he had a cataract in the left eye. The eye was painful and moderately injected; the cornea was clear, the pupil free, the lens cataractous, and vision was *nil*. The right eye was normal. The left eye was enucleated Oct. 4, 1907.

Pathologic Condition.—There were secondary glaucoma, an old perforating wound of the cornea limbus, remains of the foreign body encysted in the sclera near the optic disk, slight siderosis bulbi, moderate cupping of the optic disk and moderate atrophy of the retina. The filtration angle was open on one side and closed on the other. On the closed side the ciliary body and the root of the iris were greatly atrophied. Elsewhere the ciliary body was almost free from atrophy. The ligamentum pectinatum in places was covered with a delicate hyaline membrane. The spaces of Fontana were not obliterated. The iris was practically normal except at the point where the root adhered and at the pupillary margin (probably due to the fact that the peripheral synechiæ became separated on one side before there was atrophy of the iris root, so that the circulation of the iris was not seriously interfered with even on the adherent side).

CASE 6 (2-998).—*Clinical History.*—The patient was a man aged 41. Eleven years ago the left eye was inflamed and painful (iritis?). The present attack of pain and redness began five days ago. Vision was *nil*. There were posterior synechiæ

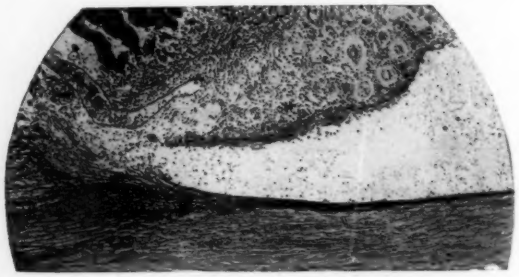

Fig. 4.—Case 9. Primary glaucoma. Ligamentum pectinatum covered with a new-formed elastic membrane continuous with the membrane of Descemet. Elastic-tissue stain.

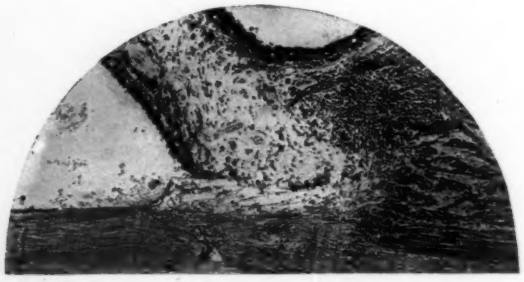

Fig. 5.—Case 7. Primary glaucoma. Iris in act of pulling away from ligamentum pectinatum.

and hyphemia. The tension was + 1. Right eye, vision 20/50. The left eye was enucleated Aug. 1, 1904.

Pathologic Condition.—Advanced secondary glaucoma was present and old iritis with exclusio pupillæ; no cyclitis, old or recent. There were deep cupping of the optic disk, advanced atrophy and complete separation of the retina (subretinal coagulum), recent hemorrhagic retinitis and obstruction of both central retinal vessels from endovasculitis. The iris was highly atrophied; the ciliary body only slightly so. The filtration angle was closed on one side only. The ligamentum pectinatum was not greatly altered, even where the iris was adherent, the trabeculæ and spaces of Fontana everywhere being well seen. On the open side, along the surface, the spaces of Fontana were closed off by proliferation of the stroma cells. On one side, at the site of the adhesion, there was evidently a state of tension, broken strands of iris tissue bridging the angle. The strongest adhesion here was that between the anterior part of the ligament and the iris. It is evident that ultimately the picture seen in Case 8 (Fig. 7) would have resulted. The internal spaces of Fontana were dilated, due, probably, to traction on the trabeculæ. The dilated spaces of Fontana and the irregular spaces formed by the breaking adhesion were frequently found filled with blood, which was continuous with an interstitial hemorrhage in the root of the iris. The canal of Schlemm was almost obliterated.

CASE 7 (2-1646).—*Clinical History.*—Patient was a woman aged 61. About six years ago a cataract began in the left eye. For several years past the eye had been painful and for the past eighteen months it had been absolutely blind. The tension was + 1. The right eye was normal (?). The left eye was enucleated Jan. 23, 1909.

Pathologic Condition.—There were advanced primary glaucoma, deep cupping and cavernous atrophy of the optic nerve, advanced atrophy of the retina, moderate atrophy of the iris and almost no atrophy of the ciliary body and active recent iritis with posterior synechiæ and pupillary membrane. The filtration angle was open almost everywhere. The ligamentum pectinatum showed three grades of sclerosis: a, vascularized connective tissue over its surface without complete obliteration of underlying spaces of Fontana; b, thick layer of dense fibrous tissue on its surface, with almost complete obliteration

Fig. 6.—Case 10. Hemorrhagic glaucoma. Iris in act of pulling away from ligamentum pectinatum.

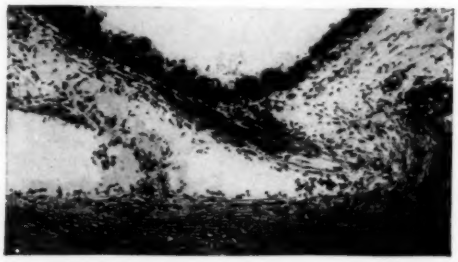

Fig. 7.—Case 8. Primary glaucoma. Iris root pulling away from ligamentum pectinatum and held only by a strand of iris tissue containing a blood-vessel.

of the spaces of Fontana (Fig. 2), and c, condition intermediate between a and b (Fig. 1). Where the angle was closed the adhesion was evidently old, but was in the act of pulling away from the ligament. Here the spaces of Fontana have disappeared, and irregular strands of iris tissue, clearly under tension, some of them containing capillaries, stretched between the surface of the ligament and the iris (Fig. 5).

CASE 8 (2-1900).—*Clinical History.*—The patient, a man aged 67, has had no vision in the left eye for fifteen years. Three years ago he began to have attacks of redness and pain. Six weeks ago he began to have pain in the right eye and to see colored rings around lights. Vision of the right eye was 20/30; field considerably contracted. The left eye was enucleated April 16, 1910.

Pathologic Condition.—There were advanced primary glaucoma, deep cupping of the optic disk and advanced atrophy of the retina and iris. The ciliary body was moderately atrophic. The pupil was free. The filtration angle was everywhere free, except as noted below. The ligamentum pectinatum in places

was covered with a layer of vascularized hyaline tissue, sometimes containing elastic tissue and presenting a smooth surface lined by endothelium. In other places the spaces of Fontana were partly opened and the surface of the ligament was ragged, showing portions of iris tissue adherent to it. Here, the opposite surface of the iris was also ragged. In one place the angle was bridged by a strand of iris tissue containing a blood-vessel (Fig. 7). The spaces of Fontana were for the most part obliterated, and the trabeculæ were not easily recognized.

CASE 9 (2-1792)—*Clinical History.*—The patient, a man aged 66, twenty-eight years ago was struck in the left eye with a stone, but the eye gave no trouble until two years ago, when it became inflamed and painful; it had been subject to recurring attacks since them. The cornea showed an old central scar with calcareous deposits—atheromatous ulcer. After the calcareous deposits were scraped out the patient neglected treatment and ulcus serpens ensued. The right eye was not glaucomatous; vision was 20/30. The left eye was enucleated Nov. 28, 1909.

Pathologic Condition.—There were advanced primary glaucoma, deep cupping of the optic disk, advanced atrophy of the retina, moderate atrophy of the iris and ciliary body, active ulcus serpens without perforation and purulent iritis. The filtration angle was for the most part open; in places partly closed. The ligamentum pectinatum was covered with a newformed elastic membrane continuous with the membrane of Descemet (Fig. 4). The spaces of Fontana were not obliterated and the trabeculæ were well seen. Where the angle was partly open, the adhesion covered about two-thirds of the ligament. Here it was sometimes seen that the adhesion was in the act of separating at the apex of the angle, leaving only the anterior part adherent.

CASE 10 (2-1935).—*Clinical History.*—The patient, a man aged 57, had hemorrhages into the vitreous of the right eye five years ago. Three years ago the vitreous was clearer, vision equaled hand movements. One year ago he had an acute attack of glaucoma, which lasted about one month. There was recurrence of tension and pain. The left eye showed sclerosis of the retinal vessels, no glaucoma and normal vision. The right eye was enucleated Dec. 10, 1910.

Pathologic Condition.—There was advanced hemorrhagic glaucoma. The retina was atrophic and covered with hemorrhages. There was deep cupping of the optic disk. Complete obstruction of the central retinal vein. The filtration angle was open around one-half of its circumference. On the adherent side, the iris and ciliary body were highly atrophic and there was ectropion uveæ; on the open side there was distinctly less atrophy and no ectropion. The ligamentum pectinatum on the open side was covered wholly or in part with a layer of vascularized connective tissue, having a smooth surface and continuous around the angle with the iris. At the place of transition between the closed and open angle, the adhesion was in the act of pulling away from the ligament, the tissue intervening between the iris and ligament evidently being under tension (Fig. 6). In places the apex of the angle was freed, leaving the anterior portion of the ligament adherent, but in other places the anterior portion was being freed first.

In each of the above ten cases the glaucoma was in an advanced stage, with deep cupping of the optic disk and marked atrophy of the retina. Three cases were of primary, one of hemorrhagic and six of secondary glaucoma. Of the latter, one was due to old iritis of unknown etiology, with exclusion of the pupil, one followed discissions of a traumatic cataract, and four followed perforating wounds of the globe in three of which there were retained foreign bodies and siderosis bulbi. In only the first three cases was the filtration angle open all around. In the others there were peripheral synechiæ of greater or less extent which might well have been overlooked if the eyes had been sectioned without this point in view.

These cases seem to me to offer convincing evidence that the sclerosis of the ligamentum pectinatum that has thus far actually been observed in glaucoma, is not the cause of the latter, but the result of preceding peripheral anterior synechiæ. The most important evidence, perhaps, is furnished by the last five cases in which the iris is found in the act of pulling away from the ligament (Figs. 5, 6 and 7), thus showing plainly that peripheral synechiæ had once been complete. This is strongly supported by the fact that the changes in the ligament in all the cases involved chiefly its surface. Moreover, the fact that the condition in question occurred in secondary, as well as in primary, glaucoma, is almost alone sufficient to prove that the sclerosis was not the cause of the increased intra-ocular pressure. In three of the cases, it is true, there was slight siderosis, so that it is conceivable that here the sclerosis was due to iron pigment deposited in the ligament which later disappeared, but this explanation is improbable from the fact that it does not apply to the other seven cases in which the changes in the ligament were similar.

The question as to the cause of the preceding peripheral synechiæ has no direct bearing, necessarily, on the question as to the cause of sclerosis of the ligament, and need not be discussed here. In the case of primary glaucoma, it no doubt involves the fundamental question relating to the cause of the increased intra-ocular pressure, which thus far has never been satisfactorily answered. In the case of secondary glaucoma, Fuchs[6] has shown that peripheral synechia frequently is due to an inflammatory condition of the iris and ligament which leads to their contact.

In all of the above cases the changes in the ligament were essentially similar, differing chiefly in degree only, and consisted in the occurrence of new tissue on its surface with more or less obliteration of the spaces of Fontana. The new tissue consisted of vascularized connective tissue, hyaline or elastic tissue, or in one case partly of tissue closely similar to the iris stroma. These changes were perhaps produced in this way. During the persistence of the adhesion of the iris root to the ligament, the openings of the spaces of Fontana into the anterior chamber became permanently obliterated by cell proliferation. If the iris then pulled away early, a comparatively smooth surface remained; if late, more or less tissue from the iris was left. Over this surface the corneal endothelium grew, and beneath it was gradually formed a hyaline layer, or even an elastic membrane (Fig. 4), identical with and continuous with the membrane of Descemet. The obliteration of the spaces of Fontana deeper down was probably due chiefly to compression.[7]

Granting that sclerosis of the ligamentum pectinatum in the above cases was due to peripheral anterior synechiæ which became separated, how was this separation brought about? In three of the traumatic cases the iris was almost free from atrophy, so that no doubt the separation occurred early, as was indicated also by the fact that the changes in the ligament were comparatively slight. Here, evidently the traction exerted by the sphincter pupillæ was alone sufficient to accomplish the separation. Fuchs[6] suggests that peripheral synechiæ

6. Fuchs: Arch. f. Ophth. (Graefe's), 1909, lxix, 254.

7. It may be well to emphasize here the fact that this paper is concerned only with the type of sclerosis of the ligament described in the literature and illustrated by the above cases. I have sections of an eye (2-1642) in which there is an entirely different type of sclerosis. Here the internal portion of the ligament is relatively normal, while in places there is marked cell proliferation immediately about Schlemm's canal. In this case there is no cupping of the disk and the filtration angle is everywhere open. On the other hand, there is albuminuric retinitis and endovasculitis of all the intra-ocular vessels, so that the sclerosis involving the wall of Schlemm's canal is no doubt simply a part of a general angiosclerosis.

associated with traumatic iritis may be freed in this way, without, however, discussing the possible effect on the ligament thereby resulting. In the cases in which there was marked atrophy of the iris, it is evident that the freeing of the adhesion must have taken place relatively late, and that it could not have been due to traction of the sphincter alone. The explanation of these cases, no doubt, lies in the cicatricial contraction of the atrophied iris. This contraction, being resisted all around by the ciliary body, must have produced a state of tension in the iris which caused traction on the peripheral synechiæ in a direction practically at right angle to the plane of the iris. The pull was therefore not toward the pupil, as at first might be supposed, but backward, or even slightly toward the periphery. The reason that such separations of peripheral synechiæ do not occur more often is no doubt due to the fact that the adhesion is apt to be especially firm in just those cases in which the cicatrization of the iris is greatest.

233 Charles Street.

ABSTRACT OF DISCUSSION

DR. M. FEINGOLD, New Orleans: What constitute the essential features of glaucoma? Is it the increased tension alone that constitutes glaucoma? Or are other symptoms of glaucoma correlated and equally essentials of the disease, such as the affection of the optic nerve? Most authors agree that glaucoma is essentially and solely increased tension and that all symptoms found in glaucoma are either symptoms leading to glaucoma or symptoms that are the consequence of increased tension. In the former group would belong such symptoms as shallow anterior chamber, small cornea, cyclitis, occlusion and seclusion of the pupil, adherent leukoma, etc. To the latter group would belong the defective epithelium and edema as well as the loss of sensitiveness of the cornea, atrophy of the iris, oval pupil, and above all the glaucomatous excavation. If it be true that glaucoma be purely and simply nothing else but increased tension we must ask, how is increased tension brought about?

Problems seen in daily practice, convince one that no one of the theories of glaucoma can satisfactorily account for all cases of glaucoma, and that for the present we are compelled to call in several of the theories to explain a single case of glaucoma. Sclerosis of the pectinate ligament, as proclaimed by Henderson to be the sole cause for glaucoma, may possibly in the future be demonstrated as the primary factor in causing glaucoma. Dr. Verhoeff's pictures prove that, at least in his case, the sclerosis of the ligament existed with peripheral anterior synechia, these anterior synechiæ having been separated during the course of the disease. Such pictures are rare because in most instances the iris is so much in contact with the cornea that the coexistent sclerosis of the ligament cannot alone be blamed for the glaucoma. Ranvier remarked years ago that the pectinate ligament becomes sclerotic with age, but no undoubted case of pure sclerosis of this ligament has been found as yet as the sole cause for glaucoma. Still such possibilities may be admitted. Could not syphilis, that plays so important a part in the morbidity of the colored race, could not syphilis with its consequent vascular changes, be held responsible for the simple glaucoma that we see in the colored race almost to the exclusion of any other form of primary glaucoma?

DR. WALTER BAER WEIDLER, New York: Will Dr. Verhoeff explain just what he means by a sclerosis of the ligamentum pectinatum; whether there was any infiltration present or not; whether there are any cases of hypopyon or whether there was any pus present in any of the specimens shown? I thought I saw deposits in the anterior chamber.

DR. F. H. VERHOEFF, Boston: By sclerosis of the ligament I mean, in a general way, thickening of the framework of the ligament. In these cases there was also new formation of connective tissue on the surface. The leukocytes in the filtration angle shown in some of the illustrations were due in one case to an active ulcus serpens, and in another to recent iritis. These, of course, were of too recent occurrence to have had anything to do with the sclerosis of the ligament.

THE KRÖNLEIN OPERATION AS AN EXPLORATORY PROCEDURE IN AFFECTIONS OF THE ORBIT

ARNOLD KNAPP, M.D.
NEW YORK

The purpose of this paper is to draw attention to the facility of the osteoplastic resection of the temporal orbital wall, commonly called the Krönlein operation, as an operative procedure, and its adaptability as a diagnostic step to obtain exact information of conditions present in the depth of the orbit such as morbid processes in the orbital walls, in the optic nerve and in the soft parts.

I take it for granted that this operation is accepted to be the best method of removing circumscribed tumors in the depth of the orbit with the preservation of the eyeball and, in many instances, with the preservation of sight and unimpeded ocular motility.

The operation, futhermore, permits the best determination of the extent of many orbital tumors, often their operability, and the securing of a proper specimen for microscopic examination as a preliminary to an orbital exenteration if found necessary, or, in the case of rapid malignity, the abandonment of further operations. The question of the advisability of the Krönlein operation in inflammatory conditions of the orbit seems to me to be still open, for it is now known that most inflammatory conditions in the orbit are secondary to disease of the nasal accessory sinuses, in which case operation at the internal orbital wall is the best.

The method of performing the Krönlein operation is sufficiently well known not to require a detailed description, yet the following points are of practical importance in my experience. The cutaneous incision should be slightly to the outer side of the periosteal incision and of the bony wound, so that the line of cutaneous cicatrix shall not be directly over and adherent to the bony margin of the orbit. The incision of the periosteum along the bony margin should be carefully made with the point of the knife directed against the bone, so that a perforation of the orbital periosteum with premature prolapse of the orbital contents can be avoided. The separation of the orbital periosteum can best be done with a sharp flat periosteal elevator. The bone-flap is formed by a medium-sized osteotome and hammer from the orbital surface, and forcibly displaced outward.

This displacement is aided by two incisions of the deep muscular tissues and periosteum, each radiating from the anterior extremities of the bony wedge. If the bone in the deeper part of the wedge has been fractured, more bone can be removed with the rongeur forceps in order to give the greatest possible access to the orbit. The bone externally at the orbital margin and malar process must not be removed, as the wedging of the bony flap in this position is necessary to keep it in place and prevent deformity when the bone flap is replaced at the end of the operation.

The horizontal incision of the orbital periosteum is held apart with small retractors and avoiding the

external rectus muscle, the index or little finger of the operator is carefully introduced into the orbital cavity. The optic nerve can then be easily identified and followed along its course to the eyeball; the orbital walls, upper, inner and lower and the apex of the orbit can be palpated. If a small tumor be present, its connection and degree of adhesion to the surrounding tissues are noted. The tumor may be isolated with the finger or a path should be carefully made to it principally by blunt dissection. The path is held open by long, narrow, blunt retractors, and the tumor extracted. The periosteal wound is closed with fine catgut sutures. The bone flap is replaced and wedged firmly back into its old position. The skin and subcutaneous parts are sutured, leaving a small opening for a cigarette drain of rubber tissue leading into the orbit if hemorrhage during the operation demands it. It is advisable to suture the eyelids, as considerable chemosis is apt to follow which will prevent the closure of the eyelids.

If the tumor in the orbit be not circumscribed and infiltrating, further steps depend on the extent of the infiltration and the possibility of a radical removal with preservation of the eyeball. If the nature of the tumor is not known, a piece of the growth can be removed for examination to determine whether the orbital contents should be exenterated or further operations abandoned.

During the past winter two cases illustrating the advantages of the Krönlein operation from this point of view were operated on by me and their operative features are briefly reported.

CASE 1.—*Patient.*—E. R. W., aged 31, referred to me by Dr. F. W. Marlow of Syracuse, N. Y., gave the history of an orbital tumor of one year's standing. A mass in the orbit could be felt on the outer and lower side of the proptosed eyeball. The Krönlein operation revealed a thickened periosteum directly continuous with a diffuse growth which seemed densest to the outer side and below the eyeball and extended to the apex of the orbit. As there was no possibility of removing this growth in any way approaching a radical manner and preserving the eyeball, a specimen for microscopic examination was obtained. This showed a tumor consisting of fibrous tissue with hypertrophy of endothelial-like cells, which was not regarded by the pathologist as particularly malignant. The entire orbital contents were therefore subsequently removed. A report of the histology of this very interesting growth together with the clinical history will be published later.

CASE 2.—*Patient.*—L. L., aged 17, was operated on about seven years ago for a plexiform neuroma of the eyelid. At present there are the irregular cicatrices in the upper lid from the old operation, ptosis, the conjunctiva of the upper lid is very much thickened and there is pronounced exophthalmos. An exploratory Krönlein operation was advised. At the operation, after reflecting the osteocutaneous flap, the orbital periosteum was incised. The introduced index finger detected a normal optic nerve, normal bony walls, but a distinct oval tumor at the apex of the orbit just beneath the optic nerve to which it seemed adherent. This adhesion was carefully broken up and a path made down to the tumor, chiefly by blunt dissection, and the tumor extracted in its entirety. It measured 19 by 13 mm. and proved to be a neurofibroma. The histology of this tumor with its complete clinical history will also be published separately. The hemorrhage from the orbital wound was insignificant. The wound was closed and a small drain introduced. The course of healing was uneventful except for some orbital induration internal to the orbital margin and a small corneal ulcer. At time of discharge the motility of the eye outward was much improved and the sight of the eye had not diminished.

10 E. Fifty-Fourth Street.

THE SURGICAL TREATMENT OF EXOPHTHALMOS

MARTIN B. TINKER, S.B., M.D.
ITHACA, N. Y.

In a somewhat large number of patients on whom I have operated for exophthalmic goiter during the past few years there have been many cases of extreme bulging of the eye. The exophthalmos is usually much improved and in some cases entirely disappears after partial thyroidectomy. As a rule, however, I have found it the most obstinate of the classical symptoms of goiter. The tachycardia and extreme nervousness which we see in so many of these cases usually clear up satisfactorily after operation, followed by prolonged rest, but once the exophthalmos has become extreme it is much less usual to see the eyes go back to normal.

INDICATIONS FOR OPERATION

The deformity is very noticeable and many women will eagerly accept any means of relief, operative or non-operative, which can be offered. The disfigurement, however, is by no means the most important indication for operation in certain of these cases. The inability to close the eyes, even during sleep, causing abnormal dryness of the cornea and increased exposure to dust and injury, not infrequently causes ulceration which endangers vision. The management of the eye condition in such cases I have invariably turned over to the specialists. In a large proportion of the cases, danger has been removed by the usual measures of treatment. Rest in bed, fastening the lid down by bandaging, or with adhesive plaster, the use of eye-shields, atropin and other medicinal treatment has usually cleared up the immediate danger to the eye. If, however, the eye does not recede, the same conditions which originally caused ulceration of the cornea bring back trouble as soon as the patient leaves the specialist, and in such cases operation is indicated to prevent this recurring danger. In a few cases there has been extreme pain in the eye, in the supra-orbital and occipital regions, which has not yielded to any form of treatment which the best ophthalmologic skill could suggest and an occasional patient has sought relief from her exophthalmos chiefly because of the pain. In a number of less extreme cases of protrusion from exophthalmic goiter, the old operation of tarsorraphy, familiar to all, is doubtless all that is required.

The edge of the lid is freshened for a short distance at the outer canthus and two or three stitches inserted which narrow the palpebral slit sufficiently to give the exposed eyeball protection and the bulging is very much less noticeable. This is such a simple procedure and so free from risk that it seems to deserve to be more commonly used than it is at present. Before advising any procedure it is best to wait a few months after partial thyroidectomy, as in quite a number of cases the exophthalmos improves so that no operation for its correction is needed. In the more obstinate cases with bad deformity, severe pain or considerable danger to the function of the eye from exposure, the more radical operation would seem indicated.

In the treatment of pulsating exophthalmos, ligation of the common carotid seems the accepted treatment and it seems unnecessary to enter into any discussion of that subject.

The osteoplastic resection of the outer wall of the orbit in the treatment of orbital tumors and the obstinate and extreme protrusions in exophthalmic goiter has perhaps not been as commonly practiced as it deserves to be.

THE KRÖNLEIN-KOCHER OSTEOPLASTIC RESECTION OF THE OUTER WALL OF THE ORBIT

Krönlein deserves credit for having proposed a satisfactory method of exposing the posterior surface of the eyeball and Kocher has suggested some important improvements. Through the kindness of Dr. A. T. Kerr, professor of anatomy in Cornell University, I have been able to make use of anatomic material and through such study have somewhat modified the operation as described by Kocher. Careful study of the anatomy of this region gives us further valuable suggestions regarding the operation. First, as to placing the incision. The original incision suggested has many disadvantages. In the first place it leaves a larger visible scar on the face than is necessary, and, perhaps more important, it endangers certain filaments of the facial nerve, making partial facial paralysis extremely likely. The usual location of the filaments of the facial nerve in this vicinity is shown in Figure 1. While there is a certain degree of variation in the distribution of these filaments, it is constant enough so that an incision can be placed in the region of the eyebrow where it is fairly well covered and the skin is elastic enough to allow it to be drawn considerably toward the field of operation. The incision is carried, as shown in Figure 2, along the lower border of the eyebrow to external angular process of the frontal bone down onto the zygoma and for a short distance outward over the zygoma. The tissues are divided to the bone, the periosteum with the overlying soft parts are separated from the bone for a considerable distance and from the outer wall of the orbit. The external angular process of the frontal bone then may be conveniently divided by the use of a thin metacarpal saw. Perhaps, better still, the bone may be drilled, a Gigli saw used, and the process divided from within outward, thus avoiding any possible danger of injuring the eyeball. In drilling through the bone the eye can be protected by holding a spatula, wrapped with gauze, firmly against the bone so that the drill-point strikes it as soon as it has pierced the bone. When the zygoma has been divided, it is an easy matter with sequestrum forceps to turn the entire outer wall of the orbit outward giving very free access to the structures in the posterior part of the orbit. The periosteum which has been separated from the inside of the outer bony wall of the orbit is divided on the external rectus muscle and the orbital fat exposed giving an opportunity to examine for a new growth of any kind within the orbit. In case a tumor is present within the region of the posterior surface of the eyeball and optic nerve, there is abundant room for careful dissection. If the operation has been thus far performed by a general surgeon, at this stage, it seems to me, the removal of the growth might well be taken up by the eye specialist who is accustomed to delicate manipulation. In any case, I believe that a competent specialist should always be present at such an operation, to advise, suggest and assist. In case no new growth is found to account for the bulging, a considerable portion of the outer wall of the orbit can be chipped away with rongeur forceps, giving a good deal of room for structures in the orbit to sink back, thus correcting the exophthalmos. I have closed the periosteum of the inside of the orbit with fine catgut, also partly approximated the soft parts in the remainder of the wound with catgut after the bony flap was replaced. With the soft parts attached over such a large surface, it seems unnecessary to use any means of fastening the bone after it is replaced. It usually comes readily into position and the skin-stitches of fine horsehair also help to hold it. The after-care of the case should be largely in the hands of the specialist.

I first used this operation with a patient on whom I had performed partial thyroidectomy, two years previously, for exophthalmic goiter. During the operation I received most valuable suggestions and assistance from

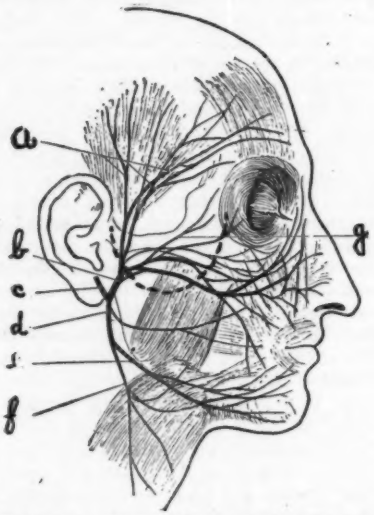

Fig. 1.—Distribution of facial nerves as shown by Corning (*Lehrb. d. Topographischen Anatomie*, after Frohse): a, temporal branch of temporomalar; b, temporofacial branch; c, facial nerve; d, cervicofacial branch; e, mandibular branch; f, cervical branch; g, malar branch of the temporofacial. Dotted line indicates Krönlein's incision as given by Bockenheimer (*Arch. f. klin. Chir.*, 1904, lxxii), who emphasizes its danger to the facial nerve. Kocher (*Operationslehre*, fifth Ed., p. 322) also urges the danger of the Krönlein incision and quotes Domela and Heibron, who collected statistics of 120 cases with injury to the facial nerve in a very large proportion.

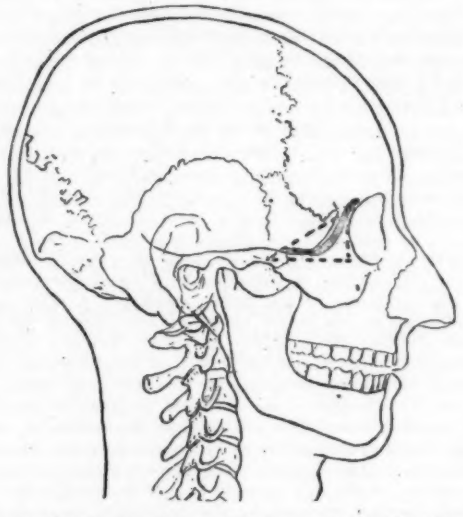

Fig. 2.—Triangle of safety for facial nerve and modified Kocher incision plotted on outline record chart in use at Anatomic Laboratory, Cornell University Medical College, Ithaca. Twenty-five student dissections plotted on this chart and verified by Dr. Abram T. Kerr, professor of anatomy, were examined. No facial filaments in triangle, twelve cases; minor filaments just above horizontal leg, eleven cases; cut by both legs, two cases; no important branches to muscles about orbit divided.

Dr. F. E. Cheney of Boston. A good-sized growth which proved, on examination by Dr. F. H. Verhoeff, of the Massachusetts Charitable Eye and Ear Hospital, to be a hemangioma, was removed from the posterior surface of the eyeball and along the optic nerve. The growth was removed with some difficulty by careful dissection. There was very little hemorrhage and the closure was satisfactory. The patient had suffered severe pain previous to the operation and the unilateral exophthalmos was very disfiguring. The result has been very satisfactory, the pain entirely relieved, and the eye returned to position not in any way noticeably different from that of the other eye. Vision is normal. For some time there was a good deal of swelling and some ptosis, which has now disappeared. There seems no apparent reason why the radical operation should endanger life, or the function of the eye, if the operation is properly performed. Removal of serious danger to vision, relief of severe pain in certain cases and correction of a very disfiguring deformity, makes the osteoplastic resection of the outer wall of the orbit a most satisfactory operation to both patient and surgeon in appropriate cases.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. KNAPP AND TINKER

DR. JAMES BORDLEY, JR., Baltimore: The views which Dr. Tinker and Dr. Knapp express are sadly at variance with my own experience. My impressions of the Krönlein operation have led me to look on it as an operation of last resort and a rather careful review of my case histories has not caused me to change my opinion. The operations which I have performed have, in the main, been unsuccessful. I do not mean to imply that the surgical procedure was not carried to successful termination, but that either the object for which the operation was performed was not gained or where the basal cause was relieved the resulting scar was a nightmare for the patient. Dr. Tinker's modifications appeal to me. The position of the skin wound and the method of handling the bone flap, I think, will greatly simplify the operation and materially lessen the resulting deformity. Even then the operation is not free from serious defects.

As an exploratory manipulation the operation does not appeal to me with half the force of the curvilinear orbital incision of Rollet. The special advantages of this operation over the Krönlein lie in the fact that the resulting skin scar is much less prominent; the bony contour of the orbit is not disturbed and the operator works in the long diameter of the orbit and is much less apt to injure the globe and the ocular muscles. In cases of long-standing exophthalmos in which the muscles are stretched it is really astonishing with what facility the globe can be shifted about. Indeed, I have seen fairly large masses removed from the orbit with great ease. Other points in favor of the operation of Rollet are that it is as simple to study the inner as the outer orbital wall and the secondary scar formation never interferes with the movements of the eye. The complications which I have seen as the result of the Krönlein operation are: an exophthalmos converted into an enophthalmos with poor motion of the globe as the result of muscular relaxation; partial blindness either from operative traumatism or atrophy secondary to pressure resulting from extensive postoperative hemorrhage; postoperative malposition of the bone flap undiscovered until the edema of the face and lids had subsided. I have had other complications.

DR. WELLS P. EAGLETON, Newark, N. J.: Dr. Bordley's remarks about the disadvantages of the Krönlein operation, I think, will be echoed by all those who have had experience with it. My experience has been limited to two operations, one of which left a very serious deformation in the way of an enophthalmos. I advocated before the academy of medicine about a year ago an operation for the extraction of a foreign body, which I mentioned was better than the Krönlein operation, giving a better exposure of the contents of the orbit. It consisted of an incision through the skin and through the fascia over the temporal muscle, separating the temporal muscle in the way in which we do a decompression operation, but farther forward, opening the temporal fossa, elevating the small part of the brain and opening the whole roof of the orbit. It appears from the description as a very serious, prolonged operation. It is very simple. It is entirely extradural, and the exposure of the orbit is so complete and so much better than in the Krönlein operation, that though I have only used it in the one operation, I have said that I believed it would be applicable to the drainage of the orbit itself in all suppurative processes. Since operating on a patient I have done the operation several times on the cadaver, and I am more persuaded that it will find a place in the surgery of the orbit. It certainly does away with the deformity of the Krönlein operation and also with the facial paralysis.

DR. LUCIEN HOWE, Buffalo: I think we should not confuse a given operation with the results which we obtain from it under different conditions. The difference between the two should be kept clearly in mind. The fact that the orbit is empty after the Krönlein operation does not detract at all from the value of the operation itself in suitable cases. In regard to the excellent suggestion of Dr. Tinker of first making the opening and then cutting from within outward, I think those who have tried it will have no difficulty in making the incision just as it is set forth in the first description if the chisel used has sharp corners. The bone is so very thin that the triangle is cut out without much difficulty. The scar seems to be in some cases at least of small significance. In one case I was surprised at the rapidity of the healing, and it was so easy that I was also surprised that I had not done the operation before, and have the conviction that I shall do it again as Dr. Knapp recommends.

DR. W. C. POSEY, Philadelphia: I have done the Krönlein operation four times, and in the last three cases I was perfectly satisfied with the results. In the first case I followed the steps of the operation as given by Krönlein himself in "Operative Ophthalmology" by Haab. I chose a curved chisel to remove the segment of bone from the orbit, as Haab recommended. The patient on whom I operated was a child with dermoid cyst of the orbit. In attempting the removal of the bone, the chisel caused the orbital rim to curl and in the subsequent healing there was some loss of bone with resulting fistula. Ultimately, however, the fistula closed and the deformity was but slight. In the remaining three cases, in all of which a narrow flat chisel was employed, a fine thin line of scar tissue remained. It has been objected that enophthalmos results from the operation. That, of course, is to be expected, after the removal of a large growth from the orbit, and can not, it seems to me, be offered as an objection to the procedure.

DR. MATTHIAS L. FOSTER, New Rochelle, N. Y.: During this discussion I have been surprised to hear so much about the bad scar left after the Krönlein operation. A few weeks ago I saw a patient on whom I performed this operation when he was a child, in 1900, twelve years ago. Now he has a paresis of the external rectus and a scar in the skin so slight that unless your attention were called particularly in that direction you would hardly notice it. Dr. Posey's remark about the curved chisel recalls to me that at that time I had no such chisel as the one originally recommended. I had only one with a thin, sharp, straight edge, and I have never thought of a curved chisel since. I have performed this operation several times and I do not think I have had a bad deformity as a result. I have certainly not seen one and I think the operation excellent for exploratory or diagnostic purposes.

DR. ARNOLD KNAPP, New York: My experiences with the Gigli saw have not been satisfactory. I have not noticed any facial paralysis. I think the operation of Rollet is excellent, but it does not satisfy the purpose of the Krönlein operation which is to remove a tumor from the back of the eye; it is not possible to get at it if you do not remove some of the bone. The operation is not a cure for all orbital conditions; it is indicated only for certain cases of circumscribed tumor back of the eye, and it seems to me in these cases the attempt should be made to try this operation. If it does not succeed,

then, of course, exenteration can always be done. The objections of Dr. Bordley can be avoided. I have not been dissatisfied with the disfigurement which I have gotten in my operations.

DR. MARTIN B. TINKER, Ithaca: I am quite convinced personally that the incision I have suggested offers a good many advantages. I should be very glad to have some of you try it, and I should also like to know the results. I have the impression that some men have not used quite as extensive a bone flap of the orbit as I have proposed. The upper part of the wall of the orbit is very fragile and I have never seen a chisel sharp enough to cut it without more or less splintering. It is only fair, however, to say that there is not necessarily very much bone deformity if the periosteum is reflected before the bone flap is cut, for the reason that flat bones reproduce readily if the periosteum is left, for example, as in opening the chest wall and resecting one of the ribs. If the Gigli saw is used in the way I have used it I am sure there will be no objection to it. It cuts a smooth, clean flap in the bone.

SUBCONJUNCTIVAL INJECTIONS IN OPHTHALMIC THERAPY *

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Since adopting the practices herein to be outlined, it has seemed to me that the most fertile field in the treatment of the graver eye diseases and injuries is, likewise, the least known and most neglected. Prior to the spring of 1904, descriptions of the methods of using, and the results obtained from, subconjunctival injections had not aroused in me sufficient enthusiasm to cause the practice to be put to trial. My first efforts were limited to salt solution only, and a few with bichlorid of mercury. Desiring a better knowledge than had been obtained from desultory reading of current journals, my earnest efforts were given to study of Darier's "Ophthalmic Therapeutics," which had been put on a shelf unappreciated. To his teachings and practice due acknowledgment is made for much of the contents of this paper, while I hope that there has been sufficient variety and extension added in some directions as to give it an individuality of its own.

I have no theory which satisfactorily explains the curative power of these injections in the wide range of conditions to which they are applicable. In inflammatory troubles they are antiphlogistic; in indolent conditions they increase circulatory activities; in septic troubles they check sepsis and, where sepsis is impending, prevent it. In specific troubles they avail much, but surely not by reason of the small amount of specific drug in them.

We may use the modern terms of "raising the opsonic index, or increasing the antibodies, etc.," or fall back on the comprehensive term of our forefathers—increasing the *vis medicatrix naturæ*. It is not drug action in itself, but some process or principle in which drugs merely figure, as antisepsis is a principle, and bichlorid or phenol (carbolic acid) merely drugs which figure in it. My practice is invariably to use as much as 2 c.c., or 30 minims, of fluid, regardless of its composition, age or condition of patient, or nature of disease or injury treated, as I believe it is the distention and flushing of the lymph-channels that is one of the chief essentials of success.

In the literature, authors often speak of injecting 1 or 2 or 5 drops of certain solutions. The only regard which is paid to the quantity of any drug used is to keep within limits of its constitutional dose, just as in an ordinary hypodermic. Bichlorid of mercury as a base was soon abandoned in favor of cyanid of mercury for the following reasons: Cyanid is much less painful, less toxic, is compatible with all the alkaloids, with epinephrin chlorid, and various other drugs which are decomposed by the bichlorid.

Darier tells of his long hunt for some preparation to palliate the tortures of injections, which he found in acoin. One of my first patients, who had received plain bichlorid injections and who was afterward given cyanid with acoin said that, although he was a poor man, no amount of money would induce him to submit to the old as compared to the new treatment.

Acoin is so easily decomposed by alkalies that I habitually combine it with a little boric acid, and keep a stock powder of one part acoin, one part boric acid and four parts salt—about one-half grain of which is dissolved in the 2 c.c. of 1 to 1,500 cyanid. The cyanid is sometimes used double that strength. Almost immediately following injection of 2 c.c. the entire conjunctiva is raised in a bleb, one-quarter of an inch or more in thickness; swelling rapidly extends to the lids, and frequently the entire side of the face, down under the chin and to the opposite side, at which no alarm need be taken. The chemosis for several days may entirely conceal all of cornea except a small pupil area. Often the conjunctiva around the needle entrance has a devitalized blackish, or sometimes buttery look, as though it would necrose, lasting for several days, but finally clears up. Only once, out of many hundreds of such treatments, has the membrane necrosed, and that over a small area which readily granulated, with just the same amount of adhesion of conjunctiva to globe as would have resulted anyway. Every time an injection is made, the conjunctiva becomes adherent to the globe over an area about as large as a little finger-nail. In some very rebellious cases requiring eight or ten repetitions, the subconjunctival space is entirely obliterated, but it causes no limitation or discomfort of movements, or distortion of lids. The eye simply looks like white marble, and no more injection can be made for lack of space to accommodate it. One eye such as this required removal because of a subsequent injury, and the parts were solidly matted together.

In these treatments speculum and forceps are entirely superfluous, as the needle-point readily picks up the membrane. The preferable points are midway between the recti muscles, and as far away from the cornea as possible, endeavoring to prevent the raised area from immediately reaching the cornea, which it ultimately does. A few trials of 3 c.c. or more produced so much swelling that it was feared necrosis would result from the opposite sides compressing each other, and this amount is at present considered excessive.

Notwithstanding the great reduction of pain by acoin, it was still, in some cases, so agonizing as to call for a hypodermic of morphin. For the past five years I have regularly put one-eighth grain of morphin and a like amount of dionin into the injection fluid in cases not already painful, and one-quarter grain in conditions already severely painful, as glaucoma. The pain varies in different individuals from ten minutes to a half hour usually, in rare instances lasting several hours. Where a dilated pupil is also desired, 1/100 of atropin is put in, which acts very quickly on the pupil.

It requires from two to four weeks for the ecchymosis to disappear entirely, but it is not conspicuous. The majority of cases require only one treatment; obstinate

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.

cases, as of interstitial keratitis, are not submitted to repetition oftener than once or twice a month. In this disease, unless peculiarly violent, only one injection is given into each eye. The same is true of most infections and traumatisms.

I believe in one strong sledge-hammer blow, instead of frequent tack-hammer licks, to which the daily or tri-weekly injections of salt solution, usually recommended, might be compared. Small children, in whom a single injection would save an eye from enucleation, have been put under a general anesthetic, but they stand the same amount of fluid as the adult. Darier's latest work speaks very highly of a watery saturated solution of guaiacol in tuberculous troubles, both as to its curative and analgesic effects. Only a few opportunities have presented for trial of this, which will probably do away with the need of morphin.

It shall be my endeavor to confine the cases reported to those in which treatment would be considered impossible by other recognized means, or in which better results are obtained than by well-sanctioned treatment, or in which the same results are obtained much more quickly and surely than by time-honored and authority-sanctioned procedures.

By far the largest use to be found for this procedure, is in advanced or dangerous corneal ulceration. Simple cases are not subjected to injection, nor those which do well under established treatments, ranging from boric acid to actual cautery or curet, but where the cornea is extensively ulcerated or breaking down, or the pupil area is involved or threatened, or the infection known to be especially virulent, the sooner used the better. Not only is healing more sure and rapid, but the cornea is remarkably clear as compared to scar formation in general, sometimes requiring oblique illumination to detect whiteness where ulceration was fairly deep. Accepted measures are used in addition, except for the few days when the swelling is so great that the cornea is practically covered by it. Non-resident patients may be sent home during this period, with instructions to keep secretions washed off, and a clean pad on the eye. If the patient is seen every day, the use of any local measures is considered as merely a placebo, to keep the patient contented while this extreme swelling persists. My first concern in all cases of corneal ulcer is to see if the tear-sac is suppurating and, if it is so, and if the ulcer is central, the tear-sac is destroyed, the ulcer burned by actual cautery and the injection made at the first treatment. These cases are usually so virulent that delay of a single day spells disaster.

After treatment as outlined above, the early ulcer usually heals promptly without any further ado. If it has nearly perforated, it will probably be destroyed because of being one or two days too late in receiving treatment. Where the ulcer is not central, the injection is withheld until other means are tried, and their inability to check advance of ulceration or infection is demonstrated. Where increased tension exists, it is well to make a paracentesis at the time of injection. The majority of ulcers, if taken reasonably early, receive only a single injection. Cases of long standing, with large or deep areas of necrosis, may require repetitions every two or three weeks until healing occurs. The greater transparency of the cornea in cases so treated has already been mentioned. I shall not report cases under this heading, but give illustrations of other conditions in which the treatment applied is believed to have demonstrated its claimed efficiency.

CASE REPORTS

SYMPATHETIC INFLAMMATION

CASE 1.—*Patient.*—April 8, 1904, J. S., a miner, applied for advice as to when he might resume the use of his one eye, the other having been destroyed by a gunshot three months previously. The destroyed eye had no cornea left, being entirely white, and square-shaped rather than round, but not inflamed or tender. The good one had full vision, and under homatropin three-fourths of a diopter of plus astigmatism and absolutely sound.

Treatment and Result.—The patient was warned of the possibility of harm to the other eye, and told to come back on the slightest sign of disturbance to it. April 26 he returned with the feeling of a foreign body in the eye, but no redness or tenderness or diminution of vision. A few almost invisible specks on Descemet's membrane were detected, and he was advised to allow prompt removal of the blind eye, which was done under local anesthesia, injection with sterile water and an infinitesmal quantity of cocain. Atropin and dionin were put in the good eye, hot fomentations used, iodid of potash given up to toleration, mercurial inunctions used to the limit, pilocarpin sweats induced, and sodium salicylate given in the massive doses recommended. In spite of these, the disease progressed until patient could hardly count his extended fingers. The turbidity of vitreous had veiled the fundus beyond vision, and it seemed as though the case was hopeless. After failure of these measures, injection of salt, then of salt and bichlorid very weak, with no apparent benefit. May 20, by an error, 30 minims of 1 to 500 bichlorid was given when the 1-5,000 was intended. Although this caused a large area of the conjunctiva to turn very dark, it did not slough, but caused the progress of the disease to check, and from that time on improvement took place steadily. June 9, the use of cyanid was begun and as this was an early case with little experience behind it, the quantity used in the twelve treatments ending August 20 ranged from 10 minims of a 1 to 4,000 to 30 minims of 1 to 3,000. By this time all active symptoms had entirely ceased, the pupil was dilated and immobile, vitreous clear, and chorioid in its peripheral area studded with waite spots about one-fourth disk diameter in size. The refraction was moderately myopic, and correcting-glass gave about 20/40 and fine print near. Examination Feb. 3, 1912, showed pupil natural size, responsive to light; dilated by homatropin to size fixed by adhesions originally. With S-1.50 vision 18/30+, Jaeg. No. 1—Tension normal; gives no trouble of any kind.

Several cases of chorioiditis illustrating various forms and severity will be presented.

CASE 3.—*Patient.*—Man, aged 44, reported with iritis of two weeks' duration, iris bound to lens, to free which a quadruple-strength solution of atropin was used for several days. The patient said that he had had rheumatism, for which constitutional treatment was given. Before long, maculæ showed on forehead and he admitted then that he had recently been under treatment for syphilis, and constitutional treatment was changed to mercury.

Treatment and Result.—In due course of time iris became freed, pain and inflammation ceased, and vision was well on the way to restoration when it began to rapidly go down from chorioiditis. Mercury was pushed to limit, and when vision reduced to about counting his extended fingers, a single injection by the present time formula of 1-to-1,500 cyanid with ⅛ grain each morphin and dionin, as well as the acoin anesthetic, was administered, with very little suffering, and usual great swelling. The vision came up as rapidly as it had gone down, the fundus soon became again visible and the floating exudate absorbed, and in a few weeks vision rose to 18/40, finest Jaeg., which is its present status, eight months later. The vitreous has a small floating spot which will always remain. It is just as likely the slight reduction of sight is from the iritis as the chorioiditis.

CENTRAL MACULA CHORIOIDITIS

CASE 5.—*Patient.*—Man, aged 23; four weeks previously he had lost central vision in one eye for large headline print, and

proportionate reduction for distance. Peripheral vision was best and fundus easily seen, vitreous being clear.

Treatment and Result.—He had been taking orthodox treatment from competent oculist to no avail. Although it was late at night when patient was seen, it was not deemed prudent to defer injection at all, and this was given well nigh midnight. Very soon improvement became evident, and in less than two weeks vision became absolutely restored, far and near.

INTERSTITIAL KERATITIS

CASE 8.—*Patient.*—V. R., girl, aged 17, came in June, 1905, with ground-glass whiteness of several weeks' duration in the cornea of the right eye. Patient could count fingers only.

Treatment and Result.—After ordinary treatment for some time, cyanid injection was given with rapid clearing of cornea. This was before the use of morphin and suffering was correspondingly severe. In time, far and near vision reached full standard. She subsequently developed the same disease in the other eye, and her dread of injection was so great that her protests against its use were yielded to, and although the severity of affection in this latter eye by no means compared to the first, its final standard was very much lower.

CASE 9.—*Patient.*—A. R., a sister of Patient 8, aged 16, came in the summer of 1906 with the same disease in one eye. As Patient 9 was a deaf mute, the issue was more vital to her.

Treatment and Result.—In addition to established routine local and general measures, she was given two injections; a short time before the disease abated in this eye, the other developed the disease, and it was also given two injections. Several months elapsed between the beginning of the first and the end of the second attack, yet both corneas were not only clear, but brilliant. Asthenopic symptoms manifesting themselves one year later, the eyes were refracted, with full vision in each. Reexamination Feb. 20, 1912, showed no vestige of line or haze in either cornea and vision was full standard far and near.

Cases thus treated are relatively free from the fine thread lines permeating the cornea, which are remnants of the new-formed vessels. Some cases of pannus crassus, in which the vessels cover everything, hardly leave any visible streaks.

GLAUCOMA FOLLOWING RETINAL HEMORRHAGE

CASE 12.—*Patient.*—Mrs. H., aged 59, reported on May 6, 1911, on account of sudden loss of sight in the right eye a few days previously, which was due to extensive disseminated retinal hemorrhage. The other eye was normal. To lessen danger of vessels elsewhere giving way, patient was sent to her home in the country with directions to stay in bed and take Epsom salts up to the limit, and was put on iodin preparations, restricted diet, etc., under supervision of family physician. She had for some time been suffering severely from headaches. Things went well until she returned on May 22, with the eye congested and painful, for which epinephrin drops, and alkalies internally, were given. Things went on to the worse and developed an agonizing, painful glaucoma, which did not abate from local or internal medication.

Treatment and Results.—As all authorities say that iridectomy is useless in these hemorrhagic cases, and leads to enucleation, she was given, on June 9, after paracentesis of cornea, an injection of cyanid and morphin with a few drops of epinephrin (adrenalin P. D. & Co.) added. The relief was immediate and lasted several days, but pain gradually returned and in spite of physostigmin (eserin) became so severe as to require another injection June 17, omitting paracentesis this time. From lack of paracentesis probably, relief was not so great this time. I started for the Los Angeles meeting next day with many regrets at leaving a patient in such bad plight. A single communication a few days later reported pains as still existing, but on getting home I was gratified to find that the patient had soon become entirely comfortable; she has not had a pain up to the present, although the eye-ball continues to be as hard as ever.

Darier asserts that injections of weak solutions of epinephrin will surely reduce glaucoma tension; this I have realized in a number of cases in which the glaucoma was a complication, but I have not had cases of the primary disease to try it on.

SEVERE EPISCLERITIS

CASE 14.—*Patient.*—F. S., man aged 28, had been suffering in both eyes with subacute episcleritis for three months. This had resisted skilled treatment at the hands of a colleague, and as the patient was handicapped in earning his livelihood as a chauffeur, he was naturally anxious to find the quickest relief possible.

Treatment and Result.—Aspirin in large doses was used a few days without benefit, and on May 17 the eye worse affected was given the dionin morphin and cyanid injection, and as soon as swelling subsided sufficiently to permit this eye coming open, which was three days, the second was given similar treatment. After the pains of the treatments passed away, there was no pain any more in either eye, and as soon as chemosis left both eyes the patient was enabled to return to work and has had no further trouble since. At some former time, not known, he had passed through attacks of mild disseminated chorioiditis on each side, but not affecting the central areas. Was highly rheumatic otherwise.

Mild cases of episcleritis, or protracted and more severe when patient has been found willing to give the time to them, have been treated in the usual way locally and constitutionally, with actual cautery to persistent nodules, and the injection reserved for the more refractory cases.

DOUBLE OPTIC NEURITIS FROM SALVARSAN

CASE 17.—*Patient.*—A girl, aged 19, reported Jan. 15, 1912. She was referred by a physician who gave her salvarsan November 10, for an infection of two months' duration. On Dec. 31, 1911, the left, and Jan. 2, 1912, the right eye had a cloud suddenly appear before it, covering the central sight. Peripheral vision unaltered. Right vision 9/200, Jaeger 14; left vision 18/120, Jaeger 8 at 15 inches. Sclera was white, with engorgement of the normally visible arteries. The right optic disk was too blurred to be definable; the left barely definable.

Treatment and Result.—Right eye was given injection of morphin, dionin and cyanid. January 19, right vision 18/120, Jaeger 12; left vision, 18/120, Jaeger 12. Injection was repeated on the left side January 25. Right vision 18/80+, Jaeger 4+; left vision 18/80, Jaeger 4+. January 27, right vision 18/50, Jaeger 2; left vision 18/80, Jaeger 2. Together Jaeger 1. Patient returned home; came back February 14 with right vision 18/40+, Jaeger 1 easy; left vision 18/40+, Jaeger 1 easy. Optic disks were still very hyperemic. Engorged vessels were decidedly reduced. Injection was repeated on the right, and on left on the 19th, on the assumption either that further good might result, or that the liability of relapse might be lessened, should such tendency exist.

Finally I turn to the great field of eyes which have been cut, penetrated, punched or smashed.[1]

I shall here reproduce one of the cases reported, the history of which was given to the late Dr. Hubbell, at the Chicago Session of the American Medical Association, with the question if he with his large personal experience had knowledge of anything similar. He replied that he did not, and that it should be reported, but he could not say what the "dope" had to do with it.

CASE 19.—Oct. 14, 1907.—Oliver D., aged 48, while hunting, received in eye from a considerable distance a No. 8 shot from gun of companion. Examination was made the same evening; the eye-ball was full of blood and vision gone. A small slit

1. A paper entitled "A Method of Preserving Eyes Which Are Usually Removed" was presented by me before the Specialties Section of the Pennsylvania Medical Society, Oct. 5, 1910, and appeared in the Pennsylvania Medical Journal of January, 1911, with illustrative cases, not only cases in which these conditions were recent, but also cases in which secondary inflammatory or suppurative states had already become established.

was found at center of lower lid, near margin, where shot penetrated, but wound could not be located on the ball. After explaining to patient that removal of eye was the other alternative, he was given an injection of cyanid and dionin, and returned at once to his home in another town. No pain or inflammation of any kind resulted, and when blood in vitreous was absorbed, a large spot of perfectly white sclera, many disk-areas in size, was seen in bottom of eye, most likely where shot struck, but no shot could be seen. Tension and appearance of eye were absolutely normal. It was explained to him that trouble might develop in the future, and he was told to return promptly if certain symptoms occurred. In May, 1908, he returned by reason of a fine circumcorneal congestion at lower border. No pain or tenderness. Examination showed a round bulging of iris at lower corneal angle, exactly size of a No. 8 shot. To extract it, a corneal section as for cataract was begun, and patient being absolutely without self-control, jerked away before it was completed, letting aqueous humor escape. Being compelled to go on, the section was made through front of clear lens, which was removed, and shot lifted from under iris by a scoop. Eye was bandaged and patient left to return home on a mid-day train, but he went to a saloon instead and spent the day drinking. Nevertheless, healing took place without any complication, and the eye is still in perfect condition, as far as appearances go.

"Replying Sept. 15, 1910, to a letter of inquiry, the patient says that the eye looks better than when I saw it and can distinguish light from dark."

This patient reported once in 1911, when eye looked fine, having some peripheral vision.

INJECTIONS AFTER MAGNET EXTRACTION

CASE 20.—J. L., miner, aged 23, had the right eye injured on the morning of Oct. 8, 1908. At first sight his physician perceived that the matter was serious, although the patient did not, as he suffered no pain and vision was impaired only slightly. In the afternoon the eye-ball was soft, and a small wound was recognized between the insertions of the superior and external recti.

Treatment and Result.—Entrance wound was slightly enlarged and tip of large magnet, inserted between its lips superficially, withdrew a sliver of iron 1 by 2 by 4 mm. The cyanid and dionin injection was given, and patient returned at once to his home in a nearby town. He suffered no pain or inflammation, and when swelling subsided, a large area of white sclera was seen far forward in region of the wound. Appearance of eye was otherwise absolutely normal. Prior to injury its vision was supposedly acute, but it now has a high plus astigmatism, with sloping axis, and there is no accommodation whatever. My belief is that the suspensory ligament of the lens was torn, and the lens rotated on its axis. Things have thus remained up to the present, vision being 18/40 with a + 5 Cyl, and Jaeger No. 1 with S + 4.0 added.

I once heard the late Dr. Herman Knapp say that these magnet cases made a sensational beginning, but that eventually many of them underwent slow degeneration, resulting in the end in blindness. It is to prevent this that the injections should be given after each operation, should it prove as effective as we have reason to hope.

PUNCHED WOUND IN CILIARY REGION BY DIRTY NAIL

CASE 22.—*Patient.*—G. W., aged 4, came on morning of Oct. 14, 1911, having been injured on the afternoon of October 12 in the following manner: A large nail attached to a string, holding up the door to a pigeon cage, used for live bird shooting, was forcibly jerked out to drop door, and made a clean punch in sclera, one-fifth inch below center of cornea, through which the dark ciliary body showed. Sight was gone, iris cupped and changed from blue to dirty-brown color.

Treatment and Result.—Patient was etherized, the conjunctiva drawn over the hole by two stitches, and standard injection given, and as soon as fully over the anesthetic, the boy was carried home to report in one week. He suffered no pain or inflammation, and when next seen the eye had its normal blue color and flat iris. The child being entirely unmanageable, the stitches were left to cut themselves out. On examination Feb. 2, 1912, the eye which was blind could not be singled out by the ordinary observer, having normal color, tension and volume.

If these penetrating injuries can be treated at once, it is probable that vision might be retained in some of the cases in which infection of the vitreous leads to destruction of sight in less than twenty-four hours. It is also worthy of consideration that in certain especially dangerous operative, as well as accidental, wounds, to wait for some sign of vitreous infection means failure, as this probably begins in the depths of the eye and only shows its presence when nearing the exterior.

In some cases suppuration already established in the vitreous has been stopped, but in no instance has vision been retained, or rather restored. Where wounds are known to be limited to the anterior segment of eye, it is all right to wait for the signs of infection, but if this is not sure beyond the shadow of a doubt, the injection should be given at once.

Illustrative of the first proposition is the following case:

CASE 23.—*Patient.*—A man, aged 45, had lower cornea cut through by broken glass on June 11, 1911. He was seen twenty-four hours later; the eye painful, but no sign of infection; argyrol 25 per cent. was given at frequent intervals, also atropin and hot bathing. Pain continued very severe, and on June 17, pus formation showed in wound, and injection was given. This did not cause any serious suffering, and there was no more pain afterward. Leaving town next day, the patient was referred back to his physician, but healing was prompt and uneventful.

All of the patients reported slept in their home beds, and were treated as office patients, with no pretense of elaborate antisepsis, aside from sterilizing syringe and solution. What larger fields of usefulness may exist, and what drugs to apply thereto, remains to be worked out. No reference is made to strong salt or brine injections for retinal detachment, as that has plenty of advocates, nor to sodium citrate for glaucoma, which is being sponsored by Thomas, of Oakland, Cal.

The scant attention given to the possibilities of massive cyanid injections reminds one of the step-child in a fairy story.

100 Baltimore Street.

ABSTRACT OF DISCUSSION

DR. G. C. SAVAGE, Nashville: The day of subconjunctival injections is just now dawning in this country. I believe that there is a great field for subconjunctival injections, but the American profession has not availed itself of the good to come from this line of work very largely up to the present. I suppose Dr. Jones is almost the oldest as he is certainly the most persistent in the use of subconjunctival injections in this country and what he has said in his paper may be relied on to the utmost. Dr. Jones did not tell me of those ugly immediate effects following subconjunctival injections of cyanid of mercury. I became almost scared to death the first time I used the cyanid injections, as I was wholly unprepared. The patient was more shocked than I. You must not infer that subconjunctival injections are given every day and to all patients. Dr. Jones does not do that. He has told you that if you can cure your patient by means that are milder you should do it. This is what he does. The subconjunctival injection of the cyanid will not be demanded often, but when you have cases such as have been outlined in this paper you will be pleased with the results you get—not the immediate results but

for these you will be better prepared than I was. Dr. Jones has not overdrawn the picture of that swollen face and that chemosed ocular conjunctiva. I would not treat such a patient and let the patient go home. Not only would the patient not come back, but his friends would not come. I want these patients to be in a very private room in my own institution and I want to exclude visitors for a whole week. I do not want the parents of the patient to see him or her and especially the father, if he is a muscular fellow and hard to reason with. I believe that this terrible reaction that comes in these cases brings about the beneficial effect; I do not know how. There are two objections to the subconjunctival injection of cyanid of mercury. The one I have already emphasized sufficiently, that is, the severe reaction. Orbital cellulitis produces no more alarming effect than do these injections. The other objection is the adhesion of the conjunctiva to the sclera. It is as large as the little finger-nail but appears in the beginning to be larger. If it is possible to get some agent to replace the cyanid—and I think it is—then blessing on the man who will introduce that agent. The improvement in the cases that should be subjected to this treatment is in every respect satisfactory. Especially is this true in the more severe cases of interstitial keratitis, corneal ulcers which seem to be hard to control and in connection with the other severe conditions that have been mentioned in this paper. My experience is in every way satisfactory barring the two objectionable features, the terrible reaction and the consequent adhesion.

DR. L. WEBSTER FOX, Philadelphia: Some years ago I published an article in which I quoted from an article by Dr. Charles Stedman Bull of New York, entitled the "Present Status of Subconjunctival Injections," published in the *Medical Record* in 1903. Dr. Bull went over the whole field just as we are going over it to-day. In 1892 I was in Paris and saw Darier use subconjunctival injections of cyanid of mercury. I said to him, "We cannot use that treatment in America and live." I went to Liverpool and saw Dr. Bickerton use the same drug. He said of an Irishman on whom he had used it, "I had to lock him up or I never would have lived to welcome you here to-day." I took courage at the results of my friend's experience and tried it in Philadelphia. For cruelty to a patient I know of nothing so severe. I have followed out very carefully, however, the method described in this article with a very encouraging experience. A recent French writer has found that the addition of a certain amount of sugar (apparently brown sugar) lessened the irritating effect of the ordinary normal saline and also some of the preparations of mercury.

DR. ALBERT E. BULSON, JR., Fort Wayne, Ind.: When Darier's work came out, I followed his recommendations concerning the subconjunctival injection of cyanid of mercury, but, notwithstanding the use of acoin as advocated by Darier and Dr. Jones, my patients complained bitterly of the suffering. I was so discouraged that I dropped subconjunctival injections altogether. Two or three years later, while visiting in New York City, I found that the late Dr. Bull was using subconjunctival injections of salt solutions in a large number of cases with apparently good results; he had abandoned the use of cyanid of mercury on account of the pain produced. After hearing of Dr. Bull's favorable results I again resumed the use of subconjunctival injections, first employing normal salt solutions and later solutions of dionin. For the last two or three years I have used dionin to the exclusion of all other preparations in subconjunctival injections, and while the treatment is not a specific for any and all forms of eye inflammation, I have seen some very remarkable results in conditions that had resisted all other forms of treatment. If Dr. Savage is worried about the swelling caused by subconjunctival injections of cyanid of mercury he ought to see some of the patients who have recently had subconjunctival injections of dionin. They look as though they had just come from a prize-fight and had received the worst of the encounter. But there is one advantage in the use of dionin and that is that the patient suffers comparatively little pain, and what pain there is usually lasts only a period of three or four minutes. If there has been considerable pain prior to the injection, the patient invariably experiences relief and remarks about the comfort secured from the treatment. Seldom does the patient offer any complaint about the swelling if he is assured that it is a part of the treatment and will probably bring about more satisfactory results than anything else. I have not found that the injections are of so much value in the wide variety of cases mentioned by Dr. Jones, though there are a number of diseased conditions, and particularly septic processes, in which the treatment seems to be superior to all other forms of treatment. In intra-ocular hemorrhage I know of nothing that will produce clearing of the hemorrhage like subconjunctival injections of dionin. I use from 20 to 60 minims of a 5 or 10 per cent. sterile solution and repeat the injection in from six to fourteen days, depending on results. The swelling is even greater than when other solutions are used, but the discomfort is practically *nil*, and the benefit is far in excess of the benefit from any other form of treatment used.

DR. WILLIAM ZENTMAYER, Philadelphia: I wish to report a clinical experience which seems to demonstrate that Dr. Savage's idea that it is the cyanid of mercury in the injection which was responsible for the adhesion between the subconjunctiva and the sclera is not correct. In a case of detachment of the retina in which I had used injections of saline solution, large xanthomatous areas appeared over the cornea with adhesions of the palpebral conjunctiva to the sclera. This condition persisted during the six months the patient was under observation. About a year ago I saw the patient after a lapse of ten years. The original discoloration had disappeared but there was still firm adhesion to the sclera. This would indicate that possibly future trouble might arise from this blocking of the lymphatics if the adhesion of the conjunctiva to the sclera were extended, and I should think that injections of such strong mercurial salts might have after-effects which would be quite injurious.

DR. THOMAS W. MOORE, Huntington, W. Va.: About nine years ago I used my first subconjunctival injection of cyanid of mercury. The patient was pugnacious and roaring with pain. I felt like having the patient confined until I could leave the state. The next day, however, when the pain subsided, I was astonished to see the result. The patient had come in with the iris hanging out of the eye. He had a very violent irritation and infection. The next day it was cleared up in an astonishing way. There was adhesion of the conjunctiva and sclera following, but a most excellent recovery resulted and every year the patient comes in to say what a good eye he has. I do not know of anything so good for the treatment, but we must make the injections rather weak. I think it is the violence of the reaction, possibly, that cures the disease.

DR. ROBERT L. RANDOLPH, Baltimore: I am reminded by Dr. Moore that it is not only the cyanid of mercury which is apt to produce these adhesions between conjunctiva and sclera, but that subconjunctival injections of sublimate solutions of salt, etc., may also produce the same effect and I think that this condition is not without harm to the eye. A number of such adhesions in this situation must exert a disturbing influence on the nutrition of the eyeball. In this connection I should like to say that my experience with all sorts of subconjunctival injections has been distinctly disappointing. I have never used the cyanid of mercury, though after what Dr. Jones has told us about it I might be led to think it of value in such a desperate disease as sympathetic ophthalmia.

DR. S. D. RISLEY, Philadelphia: Very early in my experience I abandoned the cyanid of mercury injections, not only because of the severe pain caused by this drug but on account of the severe and often protracted reaction. I cannot think that such extensive edemas as have been described here to-day, involving the face and periorbital tissues, are free from danger. Then, too, more or less serious and permanent impairment of function must follow the extensive adhesions of the conjunctiva to the sclera described in Dr. Jones' paper. The conjunctiva is a very important membrane—a lymphoid structure—and to destroy its function by these adhesions must interfere with the nutrition of the globe. For these reasons my judgment is against the habitual use of such large quantities of so strong a solution of cyanid of mercury, even in the serious forms of

ocular disease described by Dr. Jones. I would, therefore, employ such heroic treatment only as a *dernier ressort*.

DR. H. W. WOODRUFF, Joliet, Ill.: I have never had occasion to regret the use of cyanid of mercury. The adhesions between the conjunctiva and the sclera are of no importance because the cases in which the cyanid is used are only cases of great severity, in which the loss of the eye is imminent—serpiginous ulcer of the cornea, infection following cataract extraction, etc. I believe it is in the latter that we will find it of most value, because it is very seldom that one is able to save an eye infected after a cataract operation. I have had the misfortune to have a number of infections follow this operation, but have had the good fortune to save them by the cyanid injection. Concerning the reaction and the pain, I have not had the results some have had. I always use cocain in the solution and follow it with hot applications made constantly to the eye, and I very seldom have a patient who makes unusual complaints. Of course, the condition in which one is using it is painful. I feel so strongly on the subject that I believe a doctor instead of being put in jail for using the solution, as suggested by someone, should be put in jail for not using it where it is indicated. I use about 8 minims of a 1 to 1,000 solution with 4 minims of a 4 per cent. cocain solution.

DR. JOHN A. DONOVAN, Butte, Mont.: My observation of cyanid of mercury is that in infected eyes and in those stages of ulcer in which there is beginning hypopyon and in injured eyes, if one can get the solution in just as the infection is beginning, it can usually be checked. Guaiacol dissolved in glycerin, then in water, is a favorite solution in tuberculosis. Pain accompanies its use but does not last so long. I begin my cases with 6 minims and I never exceed 10 or 15 at the outside. If, after using cocain one injects 6 minims of the solution, then puts in dionin immediately afterward, keeping on hot applications for fifteen minutes to half an hour, the enormous reaction or pain will not be complained of to such an extent and the patient can go home.

DR. HIRAM WOODS, Baltimore: My own experience has been about the same as that of Drs. Bulson and Randolph. I have not used the cyanid of mercury injection chiefly because I saw what others did and I did not see that the results were so strikingly better than from a good many of the ordinary methods. For instance, Dr. Risley says it is a *dernier ressort*. I had a patient 78 years old with serpiginous corneal ulcer and double ectropion. His arteries were as hard as cords and he was in bad shape. One of my assistants who is an enthusiast on cyanid injections insisted that cyanid injection was the only thing that would give the man a chance. I did not feel justified in using it, so I did a Saemisch operation with very prompt recovery. It is hard to judge when we have reached the *dernier ressort*. As far as general therapeusis is concerned, except in exudative chorioiditis, I have not had much benefit from subconjunctival injections. I have seen decided results from subconjunctival injections both of salt and of dionin solutions; I cannot help thinking it must be the violence of the reaction that does good. I have seen the same thing in dacryocystitis. Most of us have had a great deal of discouraging experience in cases in which we have hesitated to take out the sac. With me, in the only cases of recovery after the injection into the sac of various solutions of copper and silver salts, etc., this injection has been followed by very intense reaction. I have seen several cases of stubborn dacryocystitis in which the reaction was intense, with swelling over the lids and down the cheek, and which resulted in cure. Whether it was a coincidence or whether it is the relation of cause and effect is a question, but the resemblance of these cases to those related by Dr. Jones is very striking.

DR. D. W. GREENE, Dayton, O.: Major Smith, with whom I had the honor of spending three months in the fall of 1909, is an advocate of subconjunctival injections of cyanid of mercury for the cure of trachoma. I did not see the patients long enough to judge of the results, but I did see a large number of patients who returned for a second injection or an injection in the other eye. The severe reaction described here I did not see. This may be a peculiarity of the natives of India. They are given 5 to 10 minims of a 1 to 2,000 cyanid solution, together with a pill of opium about as large as the end of the little finger and are put to bed. I saw these patients every day and did not see the severe reaction described. I have had considerable experience with dionin in the treatment of plastic uveal inflammations following cataract extraction and my experience with it has been very satisfactory. Of course I do not suppose any man depends on any one remedy in these desperate cases. I have used dionin in connection with other remedies so that I am not in position to say how much of the effects should be attributed to the dionin and how much to the other remedies that I used. I recall the case of an attorney from a neighboring town on whom I did a cataract operation by the Smith method. He went home with vision 20/20. He came back in a few weeks asking for glasses. I gave him distance glasses and a short time later he insisted on near glasses, as he was obliged to read his briefs in court. I furnished him with reading glasses, but he wrote me a little later that his eyes were not doing well. He went to an oculist not far from his home, who made a dingnosis of iritis. From my experience with such cases, I thought that he was more likely to have high tension. I wrote him to come and see me immediately. I had him instil eserin, 2 grains to the ounce, 2 drops every thirty minutes, and gave him sixty grains of salicylate of soda three times a day. When he arrived he could not count fingers at one foot. I put him in the hospital. Across the street was a concrete house which he could not see at all for the first three or four days. I continued the treatment and gave in addition subconjunctival injections of dionin 10 minims of 10 per cent. solution, every third or fourth day according to the amount of reaction. In a few days he could see the house. In three weeks the vitreous cleared up and he went home with 20/20 vision. I have had a similar complication after a discission, which yielded to the same treatment.

DR. NELSON M. BLACK, Milwaukee: Dr. Jones has stated that he has no theory to advance which satisfactorily explains the curative power of the cyanid of mercury injections in the wide range of cases to which he has applied them with success, unless it is the result of flushing out the lymph-channels. In reading over his paper, the following hypothesis suggested itself. Dr. Knapp in his paper remarked, "It is now known that most inflammatory conditions of the orbit are secondary to disease of the nasal accessory sinuses." Nasal accessory sinus disease is also now accorded a very prominent place as an etiologic factor in intra-ocular disease. The most recently advanced theory is that either by continuity or contiguity the blood- or lymph-circulation of the eye, or both are interfered with. The anatomic relation of the lymph-channels of the eyes and nasal accessory sinuses has not to my knowledge been thoroughly established, but sufficient work has been done to make it appear that the channels that drain both the eyes and sinuses empty into the same main sewer or lymph-channel. If such is the case, disease of some one or more of the sinuses will fill to overflowing the main lymph-channel or sewer and cause a backing up of the flow in the sewers draining the eye, the result being some extra or intra-ocular disease. Now will not filling the conjunctival sac with 30-45 minims of fluid make the increased lymphatic flow from such a head in the ocular channels of sufficient force to overcome this drawing back at the junction of the ocular and sinus lymph-channels with the main, and allow of more drainage of the eye with consequent improvement in the ocular condition? As a hypothesis I do not see why it would not apply to the cases of ocular injury as well. The facilities for carrying off infection and the products of inflammatory reaction would be increased by improved lymphatic drainage.

DR. E. L. JONES, Cumberland, Md.: As to the first objection in regard to the terrible appearance of the patient, I tell him what is going to happen. Cotton is cheap and I always cover the eye and let it stay covered so I do not scare the family to death. As to the pain, I spoke in the paper of the use of morphin, and with that you do not get the pain. One woman with tuberculosis of the chorioid came seventy-eight miles, got the injection, walked back to the train, and went home, two hours afterward on many occasions. Very seldom does the pain last over ten or fifteen minutes. The adhesions do no harm whatever unless muscle operations are necessary. These cases have grown better after lapse of time. The patient with sympa-

thetic inflammation recorded eight years ago was left with a vision of 20/40, pupil dilated and immovable. Seven years afterward that iris was movable and the vision was almost normal. As to the violent reaction of the large injection as compared with the small, I would illustrate it theoretically, by the flushing of a water-closet; a small stream of water running continuously will not flush it, but the whole charge of the tank clears it out. The other day a boy 4 years old with orbital cellulitis came thirty-six hours after the injury and in the space of one hour the swelling had increased fully 25 per cent. The eye was fixed and the veins of the retina seemed to be becoming strangulated. I gave the patient a big drink of whisky and when I was ready for the injection it was given into the brawny, inflamed tissue of the orbit. Fifteen minutes afterward the child went to sleep and had to be carried to the train. He never had a pain afterward and the eye recovered.

SYMPATHETIC OPTIC NEURITIS

WITH REPORT OF A CASE

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Inflammation of the optic nerve as the result of sympathetic disease occurs in two clinical forms, of which by far the commoner is the form associated with uveal disease of the usual type. It is the opinion of most observers that this occurs far more frequently than is known to be the case, but that the plastic exudation in the anterior and vitreous chambers, to say nothing of the intolerance of the eye to light, makes thorough inspection so difficult that the condition is often overlooked.

Enough cases have been observed, however, to establish the fact that the condition occurs not infrequently, and in the patients who have recovered from sympathetic uveitis evidences of atrophy have frequently been noted.

A much rarer form is the one unassociated with uveal inflammation, which may appear as a simple neuritis, usually of low degree, or a neuroretinitis with exudates in the macula or around the disk, somewhat resembling the deposits of albuminuric retinitis.

Such cases have been reported by Hirschberg,[1] Pflüger,[2] Harlan,[3] Pooley,[4] Brailey,[5] Gepner,[6] Webster,[7] Alt,[8] Eversbusch,[9] Spalding,[10] and others. Schirmer,[11] in 1900, tabulated seventeen cases, including those above mentioned. All were of a relatively benign type, and those in which enucleation of the exciting eye was promptly done resulted in recovery with good vision. The exciting eye presented the same variety of conditions noted in cases of sympathetic iridocyclitis, though for the most part a perforating injury had occurred, and there was also the same wide difference in the interval between the injury of the exciting eye and the neuritis of the fellow eye.

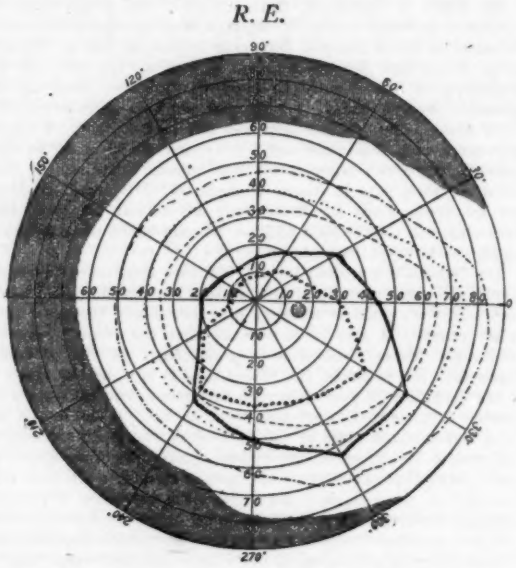
In Harlan's case, a girl of 18 had received an injury to the fellow eye "in early childhood," while in the cases of Brailey and Spalding, this interval was twenty-four and thirty-five days respectively. In some cases, the exciting eye was inflamed and tender; in others it was quiet.

1. Hirschberg: Klinische Beobachtungen, Vienna, 1874, p. 35.
2. Pflüger: Corr. Bl. f. Schweiz. Aerzte, 1875, p. 185.
3. Harlan: Am. Jour. Med. Sc., 1879, lxxvii, 383.
4. Pooley: Am. Jour. Ophth., 1884, p. 69.
5. Brailey: Tr. Ophth. Soc. U. Kingdom, 1884, p. 87.
6. Gepner: Centralbl. f. Prakt. Augenh., 1886, x, 138.
7. Webster: Med. Rec., New York, 1881, xix, 258.
8. Alt: Am. Jour. Ophth., 1884, p. 28.
9. Eversbusch: Arch. f. Augenh., 1884, xiii, 396.
10. Spalding: Tr. Am. Ophth. Soc., 1883, p. 486.
11. Schirmer: Handbuch der gesamten Augenheilkunde, 1900, vi, Part 2, p. 86.

The following case is reported as possessing certain clinical features of interest and as emphasizing the importance of enucleating sightless eyes even where they are apparently causing no trouble.

History.—F. L. N., male, aged 32, unmarried, farm laborer, presented himself for examination Oct. 12, 1911. When a child he had been struck in the left eye with a stick, which accident had been followed by a low-grade inflammation which resulted in complete blindness. He did not remember that the eye was very painful, nor had he received any treatment. The vision in the right eye had been "growing dim" for five years. The patient had consulted an oculist at the beginning of the trouble and had been told that he probably had detachment of the retina and that it was useless to do anything. The previous year, about October, 1910, he consulted some one—whose exact standing as a physician seems uncertain—who had given him —1.50 cyl. ax. 20°, which he had worn part of the time.

Examination.—In the left eye the cornea was hazy throughout, the anterior chamber obliterated, the iris degenerated, and a faint view through the pupil showed the dense white of



Visual-field chart of patient with sympathetic optic neuritis.

a calcareous lens. The eye was not tender or red; the tension was normal; the globe apparently of normal size but with no perception of light. The patient complained of indefinite pains of a neuralgic character in the right temple, and of decided failure of vision for the past six months. There was no sign of uveal disease in the right eye; the pupil reacted normally, and the media were clear. The optic disk, however, was blurry in outline and hazy with slightly tortuous vessels and of the dull whitish appearance characteristic of the onset of a postneuritic atrophy. No retinal changes were apparent. The vision was 10/200, with marked contraction of the field, as shown in the illustration. There was slight photophobia and while the state of vision made such a test difficult it appeared that the accommodation was subnormal. A careful physical examination gave no evidences of general disease; the patient's health had always been good, and he was of temperate habits. Urinalysis was negative, as also was the Wassermann test made several days later.

Treatment and Result.—The patient was admitted to the hospital, and the left eye enucleated two days after the first examination. The globe was pulled well forward so as to cut the optic nerve at the apex of the orbit, and the nerve was found to be so reduced in volume as to be little more

than a string of fibrous tissue. The temperature, which had been 99 2/5 on admission, fell to normal after the enucleation, and remained so during the balance of the patient's stay in the hospital. The pupil was dilated with atropin but beyond this no treatment was instituted for a week, at the end of which time the vision was 15/200, and the haze of the nerve had almost entirely subsided. Daily hypodermics of strychnin nitrate were then given, beginning with 1/60 grain and increasing 1/60 grain a day until 23/60 had been reached, at which time the general muscular cramps became so severe that the dose was not increased further. The daily injection was then gradually decreased. The patient was discharged from the hospital November 21, with a vision of 20/100 with +.75 cyl. ax. 90°, the field practically unchanged, and the optic nerve perfectly free from haze, but somewhat pale, and the vessels of normal size. He had had no pains since his admission to the hospital. He was given strychnin sulphate 1/30 grain three times a day, by mouth, to be continued for several months, until another examination could be made.

Histologic Examination of the Enucleated Globe.—The cornea was full of cicatricial tissue, the anterior chamber obliterated, and the atrophic iris adherent to the posterior surface of the cornea for the most part, the pupillary margin of the iris firmly adherent to the lens, the lens calcareous, the ciliary body full of new connective tissue deposits and much shrunken, the chorioid atrophic and empty of blood, the retina totally detached and degenerated, the optic nerve deeply cupped, and with the nerve fibers as far back as the point of section much reduced in size, and the connective tissue greatly increased. In other words, an old low-grade plastic iridocyclitis was shown, well advanced in the atrophic stage. There was nothing characteristic in the form of the iridocyclitis, which must have been a very chronic process not to have already caused shrinkage of the globe. There had evidently been a period of increased tension as was shown by the cupping of the nerve, as well as the changes in the anterior segment, but this also must have been of gradual onset as no history of pain or inflammatory attacks could be elicited. The optic nerve, beside the changes at the disk and lamina cribrosa, showed a very unusual degree of atrophy, increasing from before backward, as at the point of section the nerve fibers were very much smaller than at the lamina cribrosa. About 18 mm. of the nerve remained attached to the globe, and it may be said, roughly, that the nerve at the point of section measured only a little more than one-half the diameter of the nerve immediately back of the lamina.

Diagnosis.—The histologic findings, of too late a stage for the characteristic appearances described by Fuchs, are suggestive, but nothing more, while the main points in the diagnosis must rest on the absence of any other exciting cause, the type of the inflammation, and the marked tendency to improvement without treatment after enucleation of the exciting eye. It is difficult to assign much importance to the symptoms of ciliary irritation, which were somewhat indefinite, and might have been caused by the wearing of the minus cylinder. The gradual onset of the neuritis in the right eye, taken in connection with the evidence of low-grade, plastic inflammation in the left, is also interesting. It seems fairly certain, after having made every allowance for possible inaccuracy, that the neuritis had been coming on for at least six months, and the fact that the history was of a *gradual* failure of vision, extending even into the atrophic period, shows that at no time did the engorgement reach sufficient height to interfere seriously with the vision, which was impaired rather by the gradual extension of the inflammation. The persistence of a certain degree of atrophy is natural under the circumstances, and, taken in connection with the history, is indicative of a long-standing inflammation.

Several of the earlier cases reported are of interest, as representing the usual type of the affection.

In Harlan's case, a girl of 18, admitted February 11, had been blind in the right eye for many years; for the past week the vision in the left eye had been diminishing. The right eye had been injured by a blow from a stick, in early childhood, and since then it had been quite blind, frequently irritable, and occasionally painful. "There was disorganization with phthisis of the right eye, apparently the result of panophthalmitis." There was no pain at the time of examination, but the ball was tender on pressure. The left eye had no other symptoms than swollen disk, and whitish deposits in the macula (urine normal), V = 18/126. Enucleation was done and two days later, without other treatment, V = 18/70. Patient was discharged April 3, with V = 18/25.

Pooley's case was one of pure neuroretinitis, and is interesting from the fact that the injured eye showed intense neuroretinitis. The patient recovered after enucleation of the injured eye had been done.

Lenz[12] recently examined both eyes of a patient with sympathetic ophthalmia histologically, and his observations are of interest in the present connection, and also on account of the rarity of such comparative examinations. The infiltrations were similar in kind and degree in the two eyes. He found that at first the cells came from the blood-current, in small part from the lymph-current and wandered out. Later, there was a formation of lymphocytes in the tissue. In the retina of the sympathizing eye, there were occlusions of vessels and capillaries produced by lymphocytes, leukocytes, and loosened endothelium. About the vessels was a mantle of round cells. The veins contained centrally, rather than peripherally, thrombotic masses, which narrowed the lumen. "Hence, in this patient, who did not suffer from arteriosclerosis, the process was an embolic one, the origin of which must be sought in the other eye." Lenz further remarks that the disease starts in the posterior segment of the globe, in the chorioid, and later attacks the uvea in the anterior portion of the eye.

In Brailey's case, the patient, 27 years of age, had been wounded twenty-five days before, by a cut through the ciliary body of the left eye. On admission, "the right eye looked perfectly normal; it was not tender, slight pain was mentioned, but it did not seem to be or to have been more than trifling and of doubtful position." There were no iritic symptoms; V = 6/60. The disk was slightly swollen, and whiter than normal, with blurred margins. Mercury was given with atropin and a bandage. The patient was in the hospital twenty-three days, and his vision improved up to 6/18. There is no mention made of enucleation, and the case is weakened by lack of the very important evidence in the behavior of the neuritis after removal of the exciting eye. But it is possible that, owing to the relatively mild character of the neuritis, ordinary measures might have secured subsidence of the inflammation even where enucleation was not done.

Webster reported two cases in 1881; one patient, a boy of 8 years, had been wounded in the right eye fifteen months before. There was only a shrunken tender stump remaining. The vision in the left had been failing for three weeks, and was only 1/200. There was no external redness, but a high degree of neuritis, with tortuosity of the vessels, and hemorrhages. Enucleation was done at once, and the patient was treated with mercurial inunctions and iodids. Eight months later, the vision was 20/70 and the optic nerve was partially atrophic. In the second case, the uveal symptoms had begun, but the neuritis predominated. After enucleation the vision was 20/20.

Alt, in 1884, reported a very interesting case, which seems hard to classify and which is certainly unusual in

12. Lenz: Arch. f. Ophth., 1909, xxxviii, 214.

type. It began with a slight iridocyclitis, which soon subsided leaving a marked neuroretinitis which recovered after enucleation of the fellow eye. This is unusual, at least, in my experience. Where the infiltration begins as an uveitis it most frequently continues as such, and the neuritis is not apt to become the more severe affection, proportionately. We see few cases of mild iridocyclitis from this cause, in any event, and these cases do not exhibit a more severe neuritis. The clinical type of Alt's case is therefore of more than passing interest, as representing, perhaps, a border-line class between the two types of inflammation.

In Spalding's case, quoted also by Randolph,[13] a woman, 65 years old, was struck in the right eye by a cow's horn. The eye became severely inflamed and blind. Thirty-five days later the vision had failed almost to light perception. There was a typical neuroretinitis without other involvement. After enucleation of the injured eye, the vision rose gradually to two-thirds without any medication.

I have observed three other cases in consultation, which, being insufficient in detail, are not reported *in extenso*. In one, an unsuccessful cataract extraction was followed by iridocyclitis and phthisis bulbi. Two years later, the cataract of the fellow eye was extracted without the slightest secondary reaction. A year afterward a low-grade neuritis supervened, which was followed by atrophy and total blindness. Enucleation of the shrunken globe was not done.

Both the other cases followed penetrating wounds of the globe, with relatively low-grade inflammations which, nevertheless, progressed until the eyes were totally blind. The eyes were not shrunken and had not been irritable enough to suggest the propriety of enucleation. One patient received a fracture near the optic foramen, and the optic nerve, already inflamed, was totally destroyed; the other patient, who gave a history of gradually failing vision for nine months, would not submit to enucleation, and disappeared.

The exact status of these cases is still undetermined. Schirmer thinks that the papillitis is due to the metabolic products of the bacteria, while the familiar form of uveitis is a toxemia.

Randolph[13] says that sympathetic papillitis is a benign affection and a restoration to normal vision is the rule. "The optic nerves constitute the route followed by the metabolic products, and this has been proved possible by the experiments of Horner and Knies, who found that injections of fluorescin and other chemical agents, into the subpial space of the optic nerve at its peripheral end, were followed by the appearance of these agents all along the optic nerve and in the other eye." While admitting the benign nature of the affection, as a rule, there is evidence to show that the cases go on to atrophy and total blindness, if the exciting eye be not removed.

Sattler[14] reports a case of sympathetic neuroretinitis and serous uveitis after enucleation, with implantation of a glass globe. The neuroretinitis was the more marked feature. Vision was reduced to light perception. The glass globe was removed and the optic nerve resected for 2½ cmm. The ultimate vision was 6/10.

Sattler remarks that, "contrary to accepted opinions, sympathetic neuroretinitis and certain expressions of serous uveitis may be excited even after enucleation of an eye destroyed by a non-infectious lesion," (i. e., a wound from a bird-shot). Also, "It would appear that resection of the optic nerve yields the same prompt results which follow enucleation, if practiced for the rare and typical cases of sympathetic neuroretinitis and serous uveitis in which the operation on an infected or degenerated eye has been deferred until one or the other positive expression of this more uncommon and much smaller group of sympathetic lesions is already well under way."

It is a question if some of the cases of so-called sympathetic optic atrophy do not belong to this class, and have not begun as a low-grade retrobulbar neuritis. Certainly it is difficult to conceive of a simple atrophy from sympathetic causes, and in the cases of atrophy in which neuritis has not been observed, at least it could not be excluded.

In this connection, Pechin[15] reports two cases of great interest. In the first, a man of 51 was struck in the left eye by the flying head of a rivet, Jan. 27, 1905. The patient was in the hospital for three months, but the eye was lost. After some months had elapsed, he noticed that at times his vision in the right eye was dim. In September, 1908, the attacks of dimness became more frequent, and the vision failed rapidly. A month later, a diagnosis of optic atrophy in the right eye was made. Pechin saw the patient December 2; the left eye had an occluded pupil with no light perception; the right eye had a partial atrophy of the optic nerve, with vision ¼, and concentric contraction of the field to between 15 and 20 degrees. The general health was good in every particular.

The second case was that of a man of 57, who was struck in the right eye by a flying splinter of steel, March 27, 1906. A panophthalmitis followed, and six days after the accident, exenteration was done. The piece of steel was not found. The sclera was washed out daily, but the lids remained thickened and inflamed. On the seventeenth day the splinter was washed out, and the inflammatory symptoms rapidly subsided. The left eye, however, had become almost blind by this time; before the accident the vision had always been good. Pechin saw the patient July 25, nearly four months after the accident. There was partial optic atrophy, with vision of 1/50. No mention is made of enucleation in either case. In the discussion, Holth, of Christiania, said that he thought these cases should be considered as cases of retrobulbar neuritis due to intoxication by the inflammatory products of the uvea or vitreous.

It is evident that every patient with an eye capable of exciting sympathetic neuritis should be under careful observation, for the onset of the disease is insidious and is quite likely to escape the patient's notice, while even a relatively mild attack of neuritis, if unchecked, will probably be followed by a progressive atrophy and total blindness.

19 East Forty-Fourth Street.

13. Randolph: Norris and Oliver's System of Diseases of the Eye, 1898, iii, 732.
14. Sattler: Tr. Am. Ophth. Soc., 1904, p. 337.

ABSTRACT OF DISCUSSION

DR. ROBERT L. RANDOLPH, Baltimore: What concerns us most in this class of cases is the practical side of the matter and this lies in the fact that there is an element of danger in the retention of eyes which have been blinded by penetrating wounds, even though the external appearance of the eye may suggest no reason for concern. The insidiousness of the affection is remarkable. Within the last two years I have seen two cases in which the eye had been lost in childhood from a penetrating wound and retained well up into middle life. One of the injured eyes had been subject to slight attacks of redness with some pain. In the

15. Pechin: Bull. et mém. Soc. française d'ophth., 1909, p. 304.

other case a minute hole in the iris made by a bird-shot which had lodged in the orbit beyond was all that could be seen. In neither case would the ordinary observer suspect that the eye was blind. The presence of fine vitreous opacities in the one case and in both cases of transient attacks of haziness in front of the sound eye determined me to advise enucleation and yet the visual acuity of the good eye was normal and there was no contraction of the visual field. In my opinion an eye blind from an injury should always be enucleated when the fellow eye becomes the seat of symptoms such as those described by Thomson and others, no matter how little the symptoms may suggest a sympathetic affection. I think, too, that in these cases the good eye should be subjected at least once a year to a careful examination as to the visual acuity and particularly as to the visual field.

DR. E. E. HOLT, Portland, Me.: One of my first cases of sympathetic neuroretinitis was in a school teacher in a town where I taught forty years ago. The brow and right eye had been cut by a hatchet and sight was so poor that the man called it his "blind eye." The eyes looked well and gave him no trouble. I, however, told him he should have them examined if he noticed the slightest change, as he might have serious trouble in his good eye. He consulted me professionally Aug. 28, 1882. At this time the right, good eye, showed effects of neuroretinitis and was nearly blind. It now seemed too late to have the blind eye removed. It was not long before the sight of the uninjured right eye was entirely gone, and he had to depend on his injured left "blind eye," which had only qualitative vision.

MR. JAMES W. BARRETT, Melbourne, Australia: I have had a great experience with sympathetic ophthalmia in Melbourne. I can never see the sense in keeping any eye that has been inflamed and is blind. The particular interest of this subject to me is the relationship of supposed cases of sympathetic ophthalmitis to syphilis. I operated on a patient in Melbourne for cataract who had a severe attack of iridocyclitis, followed some four or six weeks later by the same condition in the other eye. Half of the staff of the hospital declared that we had to deal with sympathetic ophthalmia, the other half with something else. It turned out to be syphilis. The other eye had become affected in consequence of the syphilis and since that period I have had a Wassermann determination made. I suggest the possibility that the case described here may fall under that category. Has any one here present seen a case of sympathetic ophthalmitis improved after the exciting eye has been excised, after the ophthalmitis has begun? I have, unfortunately, had to deal with about sixty cases and in the whole of that record I cannot look back to any successful result once the disease has set in.

DR. F. H. VERHOEFF, Boston: About three years ago Dr. Feingold brought me sections of an eye which clinically he had regarded as undoubted sympathetic ophthalmia following injury. I found that the sections showed the changes in the chorioid described by Fuchs, but also other changes, especially in the retina, such as I have seen only in syphilis, and I expressed the opinion that the case was one of syphilis. Dr. Feingold wrote me later that the patient had developed tabes, thus confirming this diagnosis. This case has caused me to regard with suspicion the cases recorded in the literature as instances of sympathetic uveitis occurring without previous injury. I am also doubtful of the supposed cases of sympathetic ophthalmia associated with sarcoma of the chorioid, which it seems to me, may have been due simply to coincident syphilis.

DR. M. H. POST, St. Louis: About twenty-five years ago a man was brought into the St. Louis City Hospital with an injury of the eye. I removed it and went on treating the patient. The other eye had no apparent evidence of inflammation—none of those signs we look for as being the early symptoms of sympathetic ophthalmia. The patient insisted that his sight was failing in the other eye. I took it simply to be the fear which was acting on his mind and passed it over for a day or so, but when he still insisted, I examined the other eye and found that he had an optic neuritis. I took it at the time to be simply a coincidence. He was put on treatment. He left the hospital and I do not know the ultimate result. If there is anything in this idea that optic neuritis is sympathetic, then in our cases of infection in which we have enucleated, we should be still on the lookout for the condition of the other eye, to be determined not simply by observation or the reaction of the pupil, but on the vision of the patient supplemented by ophthalmoscopic examination.

DR. S. D. RISLEY, Philadelphia: I should say, if I may judge from my personal experience, that cases of sympathetic optic neuritis are very rare. I am sure that Dr. Randolph's cases were thoroughly studied before he advised enucleation and I believe that in all such cases the patient should be given the prospective benefit of an enucleation. I have seen but one instance that I am willing to record as sympathetic optic neuritis, and in that case the disease was arrested, apparently by enucleation of the fellow eye. It is not easy to say whether in the early stages of these cases the hazy border of the nerve, increased congestion, etc., are not after all uveal disease; but in uveal disease of bacterial or toxic origin there is apt to be some slight loss in the range of accommodation which should be absent if the nerve alone were involved. Now there are many other causes, which may be coincidental for disease in the uninjured eye, e. g., syphilis or sinus disease. In optic nerve disease associated with an old injury of the fellow eye, these possible causes should be eliminated; for example, a contracted field of vision with a central or paracentral scotoma, I think, should lead to a search for some possible involvement of the posterior ethmoidal cells or the sphenoidal sinus. In one case in which I had advised enucleation there was a paracentral scotoma. The trouble proved to be due to a diseased sinus. This, therefore, should be excluded. Without taking more time I should like to say in reply to the inquiry of Mr. Barrett that in one instance of a genuine sympathetic ophthalmia, I saw recovery after the enucleation of the injured eye. In this case, there was the characteristic symptom-complex. The patient, then a boy of 12, was seen recently after the lapse of fifteen years and vision equaled 6/5 and normal field.

DR. SAMUEL THEOBALD, Baltimore: I recall a case, observed many years ago, of neuroretinitis, unquestionably of sympathetic origin, in which the exciting eye was enucleated, and which, under mercurial treatment, subsided. These cases, as has been pointed out, are more amenable to treatment than those in which the iris and ciliary body are involved. In reference to the great importance of carefully investigating the real trouble in supposedly sympathetic eyes before enucleating the supposedly exciting eye, I may mention a case seen several years ago in which the "good" eye was irritable and asthenopic. Because of this condition, the patient had been advised to have the blind eye enucleated. Although vision was normal, a very considerable amount of astigmatism against the rule was found. When this was corrected he had no further trouble with the "sympathizing" eye, and the other was not enucleated. One should go slowly in such cases.

DR. JOSEPH S. LICHTENBERG, Kansas City, Mo.: In the case of a locomotive engineer, aged 42, who was injured by the explosion of a glass water gauge, I had the unique experience of seeing sympathetic optic neuritis develop under observation. The patient had been treated for fourteen days before I saw him. The left eye showed a traumatic iridocyclitis, with a fine scar in the lower outer quadrant, from the limbus outward. The vision of the fellow eye was normal. The ophthalmoscopic appearance was normal. The patient was put on the usual treatment with sodium salicylate and hot applications, with no improvement. Several *x*-ray examinations were negative, though experiments with similar glass were positive. In about ten days the patient complained that the vision in the other eye was affected, the eye showing no external evidence of inflammation. At that time the ophthalmoscopic appearance was normal. A blush appeared on the papilla with decreasing vision. The surrounding retina was involved, and the vision in the fellow eye sank to about 20/80 or 20/100. Still the vision in the exciting eye was about

the same. At the same time the field in the fellow eye showed a contraction concentrically, with no scotoma centrally. Taking this as a guide, I finally enucleated the exciting eye and a prompt recovery took place. In the standard text-books there is practically nothing on the subject mentioned, except by Axenfeld, who devotes only a short paragraph to it.

DR. ADOLF ALT, St. Louis: I reported a case of sympathetic chorioiditis to this body in my chairman's address in which the patient regained normal vision of 20/20 with +1.75 D. Two and one-half months after the first sign of sympathetic disease appeared the eye had been enucleated.

DR. EDGAR S. THOMSON, New York: Dr. Randolph has touched on an interesting point germane to the present subject, and that is the slight irritation that we see in the sound eye of people who have a sightless eye in the other side. Frequently, I have enucleated the sightless eye for cosmetic purposes, thinking the other eye was normal. Immediately after the enucleation the vision would jump up to 20/15. In these cases there had been some irritation which I had not been able to recognize. The diagnosis of sympathetic neuritis must be inferential; there was nothing characteristic in my cases nor in most of the cases reported. The causes mentioned by Mr. Barrett had been eliminated. My patient did not give the Wassermann reaction, the nose was carefully gone over, the urine was examined and in every way any toxic condition which might attack the nerve was eliminated. A number of the earlier cases were treated with mercury and were not improved until enucleation was performed, so that the diagnosis rested on the history of an injury, the elimination of the conditions mentioned, and most important, the improvement of the eye after enucleation before any other treatment was instituted. That rule has been applied again and again. So in my case. The eye was enucleated and I kept the patient under observation for a week or ten days and the vision improved from 8/200 to 20/200. In the other cases this marked improvement also occurred. I cannot see that this can be interpreted in any way except that the supply of toxins had been stopped. That the optic nerve is affected by toxic influences in sympathetic ophthalmia, I take for granted is so well known that it is hardly worth while to mention it. In ordinary cases of plastic uveitis with recovery (I have observed two) the evidences of inflammation of the nerve were too marked to be ignored, and I think those who have studied the subject carefully are all agreed that sympathetic neuritis can occur. Of course, in the diagnosis it is absolutely necessary to exclude everything else very carefully.

PHLYCTENULAR OPHTHALMIA AND ITS ETIOLOGY *

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Phlyctenular ophthalmia has long been of especial interest to me because among those of negro blood, who form about 40 per cent. of the patients treated in my clinic, it is very common and shows itself under unusual and severe forms. In the 451 cases studied, only sixty-three patients, or 13.9 per cent., were white, while the other 388, or 86.1 per cent., were of negro blood. In a little paper published some nine years ago[1] I showed that of 3,050 whites with conjunctival diseases, only 438, or 14 + per cent., had phlyctenular ophthalmia, while out of 2,002 blacks with conjunctival affections, 789, or 39 + per cent., were phlyctenular cases.

That liability to the disease continues through life up to a greater age in the negro than in the white cannot be doubted. The statistical study shows that among sixty-three whites the oldest was 30 years and the youngest 8 days old, the average age being 8½ years; while among 388 persons of negro blood the oldest was 60 years and the youngest 10 months old, the average age being 16 years. In 1903, I found the average of the ages of 243 white subjects with phlyctenular ophthalmia to be 10½ years; that of 336 blacks and persons of negro blood, 15⅜ years. In a group consisting of fourteen whites, twenty-two mulattoes and seventy-six negroes, the average of the whites was 10¾ years; of the mulattoes, 12½ years; and of the negroes 18 1/5 years. Not only does the disease pursue its victim among the blacks up to a greater age, but types of the disease are seen in this race that I have never met with in white people. Thus all of the bulbar conjunctiva exposed in the palpebral opening to the inner or outer side of the cornea, or on both sides, may be red and thick and present one or more foci of ulceration. To this type the name of *phlycténule en plaque* is commonly applied in my clinic. In some cases the cornea is surrounded by a ring of infiltrated material, and as the limbus in persons of color is always more or less pigmented such cases look very much like spring catarrh of the bulbar conjunctiva. Confused by these appearances I once believed, and stated that children of negro blood were exempt from spring catarrh; but Dunbar Roy has proved the existence of spring catarrh in such children, and, the assertion having been challenged, I convinced myself of my mistake by closer observation. In some of these cases, however, the resemblance between the two diseases has been so close that I must confess I have only satisfied myself that I was confronted by phlyctenular ophthalmia by seeing the condition disappear under the local application of calomel.

Here, as elsewhere, the multitude of things that have been extolled as local remedies may well lead us to doubt the real efficacy of any. With local treatment I have experimented more than once within, what seemed to me, justifiable limits. In 1903[1] I published three tables presenting the cases of 421 patients treated locally only and with mercurials alone; eighty-six treated with mercury and other agents (chiefly atropin, silver, zinc, enzymol and borax-boric acid wash); and twenty-two treated without mercurials. These tables showed the greatest, least and average duration of cases arranged in groups, according to treatment, numbering from fifty-three to one individual. I cannot do better now than to repeat the conclusions reached then: "In looking over these tables," I wrote, "we are struck first by the great variation in the duration of the disease. Thus there are found patients who were discharged cured after but three days of treatment, while other cases dragged along for some sixty to 265 days. This lengthened duration seems to depend rather on the number of patients treated on a certain plan than on the drugs employed. That is to say, if a sufficiently large number of patients be treated by any plan, a certain percentage of bad cases of long duration will be encountered. Thus in 1897, 1898, 1899 and 1900, groups of fifty, fifty, fifty-three and forty-nine cases, respectively, contained many long cases, though the cases of short duration in the same group seemed to bear flattering testimony to the treatment employed; while the average duration of the 202 cases, twenty-five, twenty-three, seventeen, and sixteen days, respectively, compares favorably with that under any of the plans of treatment. These patients were treated exclusively with yellow oxid salve and calomel, locally, a limited number being given a wash of oxycyanid of mercury (1-2,000), a drug we were then trying.

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.

1. Bruns: Phlyctenular Ophthalmia in the White and the Black Races, with Notes on Its Local Treatment, New Orleans Med. and Surg. Jour., August, 1903.

But that the drugs were not wholly responsible for the long duration of some cases or for the speedy termination of others may be gathered by observing that a group of eighteen (negro) patients treated in 1901, with calomel alone, recovered in from three to thirty-two days and in the briefest average time—ten and seven-eighteenths days—of any group of fair size; while a group of three (negro) patients treated in the same year, with calomel, atropin being instilled once daily at the clinic, probably on account of the angry look of the eyes, took twenty-one, fifty-two and 119 days, respectively, to recover. It will be noticed also that the average duration of cases in which local treatments with mercurials alone were used, and of those in which mercurial treatments were employed together with other drugs, does not vary materially and may fairly be given as from fourteen to thirty days. The same is true of the cases in which the natural course of the disease cannot be supposed to have been affected by the agents employed. In eight apparently rather mild cases in which the treatment consisted of instillations of normal salt solution alone, six patients recovered in from five to fifteen days, an average of nine and one-half days.

Further experience has only confirmed the belief that mercury in some form is the only local remedy of any real value, with the frequent instillation of "B. & C.," (the borax, boric acid and camphor water wash) perhaps to keep the eyes cleansed and soothed. When we complicate the treatment by the use of other drugs they only serve to aggravate the natural course of the disease. The bad cases which grow worse under simple rational treatment, we must deal with as we would with any other spreading, deepening, threatening ulceration of the cornea. Atropin carefully used, touching with tincture of iodin, irrigations with weak bichlorid or oxycyanid solution, canthotomy, perhaps, will all play their part. The successful management of corneal ulcers in persons of poor general health, with feeble powers of resistance and repair, is a serious task, and our bad phlyctenular cases are always found in such unhappy subjects. As we all know, as Mackenzie knew and so clearly and forcibly taught more than fifty years ago,[2] the general treatment is the important thing. Hygienic living, in its widest and its most meticulous sense, alone effects real cure.

In private practice the disease, in my experience, is rare and here, where all the surroundings of our patients are good, we may often convince ourselves that a proper regulation of the diet will suffice to prevent the recurrence of attack. Some years ago a bottle-fed infant was brought to me for consultation because phlyctenulæ had appeared on the corneal limbus. The physician in charge, a very intelligent practitioner, was advised that, although the child seemed in good plight, something was wrong with the feeding. Close observation detected the fault, and on its correction a cure followed without the administration of a drug or the use of any local application.

All are agreed, therefore, that the phlyctenular outbreak is the outward sign of some general derangement. There is nothing to suggest the action of an infection from without; no ingenuity of reasoning has yet been able to ascribe liability to attack to either of the two etiologic havens of refuge, syphilis or malaria. Many have commented on its simultaneous occurrence with disease of the nose and pharynx. Mackenzie says:[2]

"It has been suggested by M. Morard (1847) that scrofulous ophthalmia is caused and kept up by a diseased state of the mucous membrane of the nostrils. He cures this by the application of a solution of nitrate of silver, of a strength of a scruple to an ounce of water, and by this means, he says, the ophthalmia is removed." A similar experience is easily to be had: of the 451 cases considered in my tabulation, 172 were examined in our ear, nose and throat department, through the kindness of my colleague, Dr. R. C. Lynch. Of this number, in 105, or 61 + per cent., rhinitis, swollen tonsils, suppurative otitis, etc., were found; but on the other hand, in 67, or 38 + per cent., absolutely nothing abnormal was discovered by the rhinologist. In a number of these cases in which we purposely refrained from treatment, correction of the nasopharyngeal conditions, removal of tonsils and adenoids, etc., was followed by rapid subsidence of the ophthalmia. As these patients soon passed from under observation, it is impossible to say how lasting was the relief.

The connection between phlyctenular ophthalmia and eczema has been observed by all. Unfortunately the exact number of our phlyctenular patients having eczema, and of those not so affected, was not noted; but Dr. T. J. Dimitry (the assistant surgeon who carried on the investigation for me, and to whom I am indebted for the tables) and I were both struck by the numbers free from this complication. This was particularly true of the older patients, and especially of the negroes, among whom great numbers may be seen with severe attacks of phlyctenular ophthalmia yet showing no trace of any skin disease whatever. Stevenson found that in 100 consecutive cases eczema existed in 58 per cent., while in another group of 529 cases it was present in 49 per cent., and in still another group of 136 cases 83 per cent. He is naturally impressed with the important part played by eczema, and thinks that phlyctenular disease is due directly to an eruption of eczema or impetigo on the eyeball. On the contrary, Wrekers says the changes are entirely different from those of eczema. Still another observer, Joseph, has observed, in thirty cases of phlyctenular ophthalmia, the co-existence of phthiriasis of the head. Treatment of the latter condition seemed always to have cured the ophthalmia.

It appears from these observations that authors have been influenced in assigning the cause for this common disease of the eyes by the place and the people among whom they worked; ascribing, by a very human prejudice, an undue influence to these frequently coexisting maladies.

Stevenson found eczema present in a large number of his cases, but even in his group of 136 giving the largest percentage, 17 per cent. were free from the disease and it is notable that the largest group (529) gives the smallest number with eczema, 49 per cent. I, on the other hand, in a subtropical climate, with a large number of negroes among my hospital patients, see very many phlyctenular cases free from any trace of skin lesion. M. Morard found nasal disease in all of his patients and its cure was followed by disappearance of the phlyctenules. One hundred and seventy-two of my patients were carefully examined by a competent, conscientious rhinologist of large experience, and in more than 38 per cent. of them absolutely nothing was found. Neither eczema nor nasopharyngeal disease, therefore, seems to me to fulfill the conditions of a true cause. No one, I presume, will become, on account of the observations of Joseph, a strong protagonist of the causal relationship between pediculus capitis and phlyctenular disease; yet all will be equally willing to admit that eczema, nasopharyngeal maladies and phthiriasis are conditions we

2. Mackenzie: Diseases of the Eye, with Notes and Additions by Addinell Hewson, Philadelphia, 1855.

would expect to find commonly among the kind of children oftenest attacked by phlyctenular ophthalmia.

Wrekers found, in fifty-eight children with phlyctenular ophthalmia, fifty-one, or 87.9 per cent., who responded positively to von Pirquet's test. Derby, in his paper read before this Section in 1910, reported fourteen cases in which the cutaneous reaction was positive in eleven, or 79.2 per cent.; and in his paper in the *Archives of Ophthalmology* he writes that of forty-three cases "classed as phlyctenular disease, because no better general term is available," thirty-eight reacted positively, about 88 per cent.; and this was the percentage found by Stock in his investigation. Wilder reported to this Section, for the Committee on Relation of Tuberculosis to Diseases of the Eye, that of fifty-three cases of phlyctenular conjunctivitis and keratitis forty-seven showed evidence of tuberculosis. It may be added that Nias and Patton stated that in twenty cases of phlyctenular conjunctivitis, the opsonic index was abnormal. But Mayou said that in five cases without evidence of tuberculous disease elsewhere, he had found the index normal.

I believe it fair to say that the case for the tuberculous cause of phlyctenular ophthalmia rests mainly on the evidence of the von Pirquet test, to which from 80 to 90 per cent. of those with phlyctenulæ respond. I was not able to get figures anything like as high as these from the children in my clinic. Out of 102 tested by the von Pirquet method, sixty-two, or 60.7 per cent., gave a positive reaction, and when forty out of these sixty-two were tested by the Calmette method twenty-one, or 52.5 per cent., were also found positive; but, what is more noteworthy, the thirty-seven, or 36.2 per cent., of the 102 cases negative to von Pirquet were all negative to the Calmette test also. My figures, then, approach those of Leber, and the evidence that 36.2 per cent. of my phlyctenular children were not tuberculous seems strong. Yet putting them aside, 10 to 12 per cent. seems to be the irreducible minimum that cannot be proved to be tuberculous even by the skin test applied to the children met with in the free clinics of big cities; cities in which the dwellings are more crowded and the conditions of life more difficult than in New Orleans, where the children are in the open air most of the year. So delicate is the skin test, that it has proved either that practically all of us are tuberculous or that the reaction sometimes takes place in persons who have never been infected. Hamman and Wolman[5] found that in *adults* a positive reaction cannot be used as evidence of clinical tuberculosis. They found that in their non-tuberculous group, a group of cases from which they had exeluded tuberculosis on severe clinical conditions, there were 57 per cent. of positive reactions to the skin test, while in their "doubtful group" the positive reactions rose to 83 per cent. A positive reaction, they say, to the ophthalmic test, made with a 1 per cent. solution of Old Tuberculin, is extremely strong evidence that the case does not belong to the non-tuberculous group. In the skin test a negative result is alone of clinical interest (moribund patients being, of course, excluded) and denotes, with a high degree of probability, either that the patient has never been infected with tubercle bacilli or that he was infected a very long time ago. This cannot be the case in children, and children are admitted by all to be even more susceptible to the test than adults. When, therefore, the test is applied to children—the children of the free clinics—with phlyctenular affections, and by those favorably inclined to the theory of tuberculous etiology, and we find always an irreducible minimum of from 12 to 10 per cent. of negative reactions, by what logic can we be justified in disregarding these ten cases in a hundred and in declaring, in spite of them, that tuberculosis is a true cause of phlyctenular ophthalmia — a cause, that is to say, which invariably precedes the effect in question. Again, those who have concerned themselves with the determination of the prevalence of tuberculosis in children, present us with astonishing figures.[6] Hamburger of Vienna, in an address on "The Incidence of Tuberculosis in Children," at the conference held in Edinburgh in July, 1910, gave the percentage of positive reactions to the von Pirquet test in children from the seventh to the tenth year as 71, and from the eleventh to the fourteenth year as 94 per cent. These are ages at which phlyctenular disease is most common. Shaw and Laird, at the same meeting, said that Albrecht of Vienna found evidences of tuberculosis in 44.3 per cent. of 1,558 autopsies on children between the first and sixth year, and in 50.1 per cent. in 335 autopsies on children between the sixth and twelfth year. Comby of Paris has lately published the findings in a series of 1,447 autopsies on children. In children over 2 years there were 435 autopsies, 283 giving evidence of tuberculosis—65 per cent. From these figures it is evident that so large a percentage of the children seen in our hospitals are tuberculous that it would be more than surprising if evidence of the disease were not found in a great majority of those with phlyctenular ophthalmia. These considerations, numberless observations of the disease in negro youths and adults of splendid physique and apparently robust health, and the fact that the recurrence of phlyctenular outbreaks is often checked by attention to the bowels and simple regulation of the diet (as in the case of the infant related above) are incompatible in my mind with belief in the tubercular theory.

Since reaching this conclusion I have found comfort in the discovery that others had felt the weight of these difficulties. Thus, Lafon divides phlyctenular disease according to its etiology into three groups. In the first, the patient has become tuberculous before the appearance of the disease, and the outbreak is probably due to the action of a tuberculous toxin; in the second, there is neither a personal nor a family history of tuberculosis, but the phlyctenules appear after an exanthema; in the third are those apparently in robust health at the time of the effloresence. In the latter an examination will usually discover gastro-intestinal disturbance, enlarged tonsils, adenoids, etc. This is the largest class and in it the eye disease is caused by an auto-intoxication. I cannot see, however, why we should ascribe the same disease in one case to the specific toxin of tuberculosis, in another to that of one of the exanthemata, and in a third to an auto-intoxication produced by gastro-intoxication or nasopharyngeal disease. It would seem more logical to ascribe the outbreak to some cause itself the effect of the several abnormal conditions.

Schuetz and Videky divide phlyctenular cases into two etiologic groups: those of exudative origin, which do not react to tuberculin, and get well on a diet free from sugar and eggs and containing but little meat; and those which react to tuberculin and are cured by tuberculin. Igersheimer, though putting the case in

5. Hamman and Wolman: Arch. Int. Med., 1910, vi, 600.

6. I am indebted for these figures to Dr. J. B. Elliott, Jr., professor of practice of medicine in Tulane University, who most kindly looked up the subject for me.

favor of the tuberculous theory in the strongest way, does not hide from himself that phlyctenulæ appear in some who cannot by any test be shown to be tuberculous. Why, he asks, does phlyctenular disease appear in the non-tuberculous and why is the child especially prone to the disease? He recognizes also that there must be a constitutional difference between those who have phlyctenular disease and those who never have it, and must have observed, as we all have, that numbers of the tuberculous never suffer an attack. In answering his question he cites Czerny's dictum that such children are of "the exudative diathesis" and are very liable to infections other than tuberculous. This seems to be but a new way of stating the old proposition that phlyctenular ophthalmia is commonest in scrofulous persons and that such persons are of delicate constitution and especially liable to derangements of health and the attacks of disease. In the new formula "exudative diathesis" is substituted for "scrofulous," and our later perception that such subjects are especially prone in early life to tuberculous infection is incorporated.

The theory that most commends itself to me is that which likens phlyctenular ophthalmia to herpes—to the mild herpes labialis, the "fever blister." Their behavior—their sudden unexpected outbreak, their mild and regular course and disappearance without bad effect when uncomplicated—is very similar. In the especial liability of children, they are alike. Phlyctenulæ are situated at the ends of peripheral nerves according to the classic research of Ivanoff, and it seems more than probable that they are neuropathic. Dr. Isadore Dyer, professor of dermatology in Tulane University, says:[7]

"I consider all herpes essentially neuropathic and I believe that the recurrence of the 'fever blister' in some individuals as a genital lesion, or about the face, is an evidence of this. Shock, any fulminating illness, excitement, acute intestinal disturbances, auto-intoxications, nasopharyngeal or respiratory disturbances may cause herpes in any of its forms."

Many of these are the conditions that precede or accompany the phlyctenular eruption. The cause of the neuropathy would seem to be some disturbance of metabolism or an auto-intoxication. In phlyctenular disease the evidence that the intoxication is usually of gastro-intestinal origin is abundant. Scrofulous children and those infected with tuberculosis are well known to be liable to such derangements. The class that we see in our clinics, unwashed, ill-clothed, sleeping in ill-ventilated and often crowded rooms, poorly fed, and at that on a diet often the least suited to their age, must in the presence of the least constitutional weakness be almost constant sufferers. It may not be always possible to get from these patients a history of gastro-intestinal derangement; but neither, as we all know, is it easy to elicit from the majority of them an account of any but the most striking illnesses. Disorders of the gastro-intestinal functions are, perhaps, with them so constant as to be regarded as a natural state of things and entirely normal. That a brisk purgation, preferably with a mercurial, and subsequent regulation of the bowels, is the measure favoring most the safe and rapid resolution of an attack, and that recurrence may be prevented by regulation of the diet, or even by the withdrawal of certain articles of food, facts recognized by hosts of observers, speak, even in the absence of complaint, of the almost universal prevalence of gastro-intestinal derangements among phlyctenular patients. How nasopharyngeal disease by restricting the supply of oxygen favors auto-intoxication, and the baneful effects of diseased tonsils are now well understood. We can readily imagine, therefore, how an organism, probably from the beginning none too robust, struggling in vain against the additional handicap of any one of these morbid conditions, becomes unable properly to digest and assimilate its food; is further overwhelmed by the toxins resulting from this failure of function, and exhibits the effects of these poisons by symptoms especially conspicuous in the skin and nervous system, and at times in the conjunctiva (hyperemia, phlyctenules)—parts embryologically not unrelated. It would seem equally clear, then, that the tuberculous process having been checked by tuberculin or by hygienic measures, the eczema having been cured,[8] adenoids or diseased tonsils having been removed, the exanthema having run its course, the especially indigestible or unassimilable food having been withdrawn, such an organism may possess strength enough to perform its functions in a fairly normal manner and the auto-intoxication and its symptoms may gradually disappear.

It seems to me, then, more logical, in the present state of our knowledge, to regard phlyctenular ophthalmia, not as the effect of a specific toxin (tuberculous) or as an ocular eczema, but rather as a neuropathic phenomenon brought about by an auto-intoxication, originating, in the great majority of cases, as the effect of treatment clearly shows, in derangement of the gastro-intestinal functions; not all persons being equally liable to these morbid processes, but much more particularly those in whom we recognize clinically the scrofulous, lymphatic or exudative diathesis; such persons being especially liable to tuberculous and to other infectious diseases, which in their turn further depress the metabolic and catabolic processes, the functions of digestion, assimilation, secretion and excretion, and thus intensify and perpetuate the state of auto-intoxication. Subjects of the disease (10 to 25 per cent.) are found, it is true, in whom we can recognize neither tuberculosis nor the signs of the scrofulous condition, but they, like nearly all those affected, belong to the least favored classes and live under conditions the least hygienic and on food but little suited to childhood, the period of life when phlyctenular disease is most prevalent. The recession of scrofula, so prevalent in all classes when all lived as only the poor live now, before advancing civilization and the increase of hygienic living, renders it not impossible that its stamp was set on the race by these unfavorable conditions, and it is possible that we see now in individuals without the earmarks of scrofula, restricted and particular effects that were once common and cumulative in the race.

7. In a note courteously replying to one of interrogation by the writer.

ABSTRACT OF DISCUSSION

DR. RICHARD J. TIVNEN, Chicago: I am not sure I interpret Dr. Bruns correctly as saying that "only rarely opacities following on phlyctenular trouble seriously interfere with sight." My own experience is not in consonance with this view, as I have observed such serious sequelæ sufficiently often to warrant the conclusion that they are neither infrequent nor rare. I agree with Dr. Bruns except on the question of the tuberculous origin of phlyctenular trouble. I am convinced that conjunctivitis eczematosa should be regarded as a manifesta-

8. Henry W. Stelwagon says, in speaking of the constitutional causes of eczema: "Digestive debility, dyspepsia, and its frequent accompaniment, constipation, must be given a high place in discussing the causes of the disease, in fact, in my experience, stand first in importance. Important an etiologic factor as it is in adults, it is even of greater influence in eczema of infants and children."—Treatise on Diseases of the Skin, Ed. 2, 1910, p. 265.

tion of constitutional tuberculosis. Its proper management must include not only the usual ocular or local treatment, but also and more particularly the constitutional measures appropriate to the treatment of tuberculosis. At the head of the constitutional agents advised I would unhesitatingly place tuberculin. Dr. Bruns' objections to the tuberculosis theory are briefly: that 10 to 12 per cent. of cases fail to respond positively to tuberculin tests; that tubercle bacilli have never been found in the phlyctenule; that inoculation with phlyctenular material in animals has failed, except in one instance; and that the phlyctenular structure shows no resemblance to tubercle; that the prevalence of tuberculosis explains the high percentage of positive reactions to tuberculin tests; that phlyctenular disease does appear in the non-tuberculous and that many tuberculous patients never suffer from an attack. Opposed to Dr. Bruns' first objection is the fact that a positive reaction is obtained in 80 to 92 per cent. of cases. In reference to Dr. Bruns' second objection, Dr. Derby's explanation may possibly be the correct one, viz., that the phlyctenule may be atypical and free from bacilli. Dr. Bruns' third objection is favorable to the tuberculosis theory, since victims of a general tuberculous process may be particularly favorable subjects for the development of a tuberculous ocular manifestation. In reference to Dr. Bruns' fourth objection, it may be said that it is not always possible to determine a tuberculosis. Many tuberculous patients never suffer from an attack but it is not essential that every case, say of pulmonary tuberculosis, have associated with it a phlyctenular trouble to substantiate the conclusion that phlyctenular trouble is of a tuberculous nature, any more than it would be reasonable to conclude, because this association is absent, that phlyctenular trouble is not a tuberculous manifestation. The tuberculosis theory of phlyctenular trouble is perhaps not absolutely established. Sufficient data, however, have been adduced to warrant thoughtful consideration.

DR. ARTHUR G. BENNETT, Buffalo, N. Y.: In an experience of a great many cases of phlyctenulosis, I agree largely with Dr. Bruns' opinion. In the Childrens' Hospital, if I am called for an eye case it is sure to be a case of phlyctenulosis. I always have a von Pirquet reaction taken and have the urine examined. One striking thing is that in every case the urinary examination shows a marked excess of indican, and my feeling has been that most cases of phlyctenulosis are due to intestinal toxemia. Undoubtedly many cases also show the tuberculin reaction but I look on it more as a coincidence than actually as an etiologic factor. In Buffalo we have a population of 90,000 Poles, and the children are kept under the most deplorable hygienic surroundings. Many of them are weaned on beer. The milk they get is horrible. They are allowed tea and coffee and the general feeding of the child is about as bad as it possibly could be. It is these children who break out with phlyctenulosis. One clinical observation brought to my attention and frequently brought to my attention by the parents is the most vile odor of the urine, and my attention has been directed to that very largely to counteract it; the therapeutic measure outside of the proper feeding which I have found to be of the greatest value is the administration of small doses of sodium salicylate. It is really surprising to notice the disappearance of indican under small doses, 1 or 2 grains three times a day. A marked improvement in the phlyctenular condition will also be seen. I am sure we can shorten an attack by putting the patient under proper hygienic conditions, such as we can get in a modern childrens' hospital. I do not feel that tuberculosis is the etiologic factor in the majority of cases.

DR. SAMUEL THEOBALD, Baltimore: Fuchs and other German authorities call phlyctenular conjunctivitis or keratitis, as the case may be, eczema of the conjunctiva or cornea. This, in my judgment, is the true nature of the affection, and just as eczema of the face and other parts of the body in children is so often due to intestinal intoxication, so, I am thoroughly convinced, is phlyctenular ophthalmia due to this same cause. Long before the term "intestinal intoxication" was coined, I taught that phlyctenulosis was due to systemic infection from the alimentary canal, and while this form of ophthalmia is more apt to occur in tuberculous or scrofulous subjects, because of their poor resisting power, it occurs over and over again in children who show not the slightest sign of a tuberculous condition. Bad hygienic surroundings, as pointed out by Dr. Bennett, unquestionably play an important etiologic rôle. The fact that the skin and other reactions indicate the presence of tuberculosis need not by any means force us to conclude that the ocular malady is of a tuberculous nature. I entirely agree with Dr. Bruns that only in rare instances is this so. One of the most valuable remedies for phlyctenular keratitis, as might be supposed from its etiology, is an energetic calomel purge. At the Baltimore Eye and Throat Hospital a powder containing 2 grains of calomel, 2 of scammony (now an almost unknown drug) and 6 grains of rhubarb is frequently administered at the outset of the treatment. As to the importance of not always attaching too much significance to the tuberculin reactions, I may mention the case of a boy brought to my office some time since with a typical interstitial keratitis. One of the first questions I asked was, "Has the child had any trouble with his knees?" The answer was "Yes, he has been in a sanatorium all summer under treatment for tuberculosis of the knee-joint." Tuberculin tests made at the Johns Hopkins Hospital, I was informed, had given positive results and he had been treated accordingly. He was put on biniodid of mercury and in due course of time the tuberculosis of the knee-joints disappeared.

DR. F. H. VERHOEFF, Boston: Dr. Bruns brings no evidence to support his conclusion that phlyctenular disease is a form of herpes other than the observation of Ivanoff, that phlyctenules occur at nerve terminals. This observation, however, is of no special significance because the surface of the cornea is so rich in nerve terminals that no matter where a phlyctenule occurred, on account of its size it would cover a number of nerve terminals. Phlyctenular keratitis certainly does not closely resemble herpes corneæ, with which we are familiar as occurring in adults and occasionally also in children. My own belief is that phlyctenular disease is always due to tuberculosis, although I must admit that the proof of this is not absolutely complete. I base this view on the large proportion of cases which show clinical evidences of tuberculosis and on the results of tuberculin tests. It is true, as Dr. Bruns points out, that the percentage of von Pirquet reactions in phlyctenular cases is about the same as that for children free from the affection. He does not discuss the fact, however, which to me is especially significant, that in certain cases the Calmette test and the subcutaneous test give rise to an outbreak of phlyctenules. In a discussion before the American Ophthalmological Society and another before the Surgical Section of the International Tuberculosis Congress, in 1908, I suggested that phlyctenular diseases, as well as the eczema often associated with it, were due to anaphylaxis, a view that later was brought forward by others. I called attention to the fact that if this explanation were correct, it would be expected that certain cases would be in a so-called refractory stage and would fail to react to tuberculin. This answers Dr. Bruns' objection, that a certain percentage of phlyctenular cases do not react to tuberculin. It would be well to test such patients again after the eye trouble had been quiescent for some time. In a similar way could be explained the fact that phlyctenular disease occurs chiefly in children, and only in a certain proportion of those infected with tuberculosis, since only after comparatively recent infection, and under certain conditions, would it be expected that the phenomenon of anaphylaxis would manifest itself locally in the eye.

DR. HIRAM WOODS, Baltimore: I know nothing more difficult than to draw proper conclusions from such data as have been given here to-day. To begin with, we take the fact that a lot of these children are ill fed, live in bad air and are dirty; we have the disease occurring in a structure that we cannot get and keep aseptic; put the patients on better food and under better conditions of cleanliness, turn them out of doors and they improve. We find, without scientific tests, that a little improvement in hygiene helps them

resist the constantly recurring infection from the nose or from the outside. Clinicians are making a careful distinction between a tuberculin skin reaction and clinical tuberculosis. Probably 75 per cent. of all children, irrespective of symptoms, will give a positive von Pirquet. What are you going to infer from that? Von Pirquet told me himself that he thought two negative results in children were positive proof of the absence of tuberculosis, but he himself did not attach an enormous importance to the positive result of the reaction in absence of clinical tuberculosis in children. Suppose you get a positive von Pirquet in these children. I question very much if that justifies us in assuming a tuberculous cause. If, on the other hand, the tuberculous origin is proved by the fact that tuberculin cures the disease, and prevents recurrence, then we have some positive proof. As to the rôle of intestinal absorption for which Dr. Theobald uses his "inherited taste" for calomel, where does a positive diagnosis of intestinal intoxication come in? Dr. Bennett has spoken of excess of indican. Undoubtedly it represents the absorption of indol, and indol is one of the conjugate sulphates resulting from intestinal putrefaction. Many internists say it is positive proof of intestinal intoxication; many others say it is not. In a recent communication de Schweinitz said he was surprised that the profession had not got rid of the fetish of indicanuria. Some clinicians in Baltimore state that after we go over all the other tests we come back to indol as the most available evidence of putrefaction. The argument against the significance of indican is that patients have these troubles without it; then they must have them from some other cause; again, they recover in spite of the presence of the indican, which means that after the various remedies, we reduce the indican to a point at which the system can tolerate it I do not believe we can draw dogmatic conclusions from any data in our possession.

MR. JAMES W. BARRETT, Melbourne, Australia: The discussion is of extreme interest to me because of the great extent of phlyctenular disease in my section of our country. It is a disease found frequently in Melbourne in hospital practice, but almost never in private practice. Our population, although very well-to-do, has curious dietetic habits. The diet is almost entirly carbohydrate. The children have bread and butter and jam and tea for breakfast, bread and butter at 11 a. m. (what they call a "piece"), a fair meal of meat and pudding at 1 p. m., another "piece" during the afternoon and wind up with tea and bread and butter in the evening. The result is that the intestine must be loaded with cellulose just as we see among the Egyptians in the clinics of Cairo. I know that syphilis has no relation to phlyctenules and I believe, with Dr. Woods, that whatever is the result of the von Pirquet, phlyctenule is not associated with tuberculosis. And we have reached the conclusion that the importance of the von Pirquet is when it is negative. The bulk of children give it and I do not know what it may mean. All that we are clear about is that it is not usually associated with these gross lesions. I shall be interested to learn from Dr. Bruns whether there is any analogy between the diet habits of the children of whom they have been speaking here and the diet habits of our own children.

DR. GEORGE S. DERBY, Boston: It does not seem possible in the light of present knowledge to say that all phlyctenular disease is due to tuberculosis, although there are some very striking facts which point to this. I think it has not been worked out yet but evidence is being gradually accumulated to show that the incidence of phlyctenular disease bears a very close relation to the incidence of tuberculosis in childhood. Now as to why more cases of phlyctenular disease do not show the gross lesions in the body, it is well known that in only a small percentage of those affected with tuberculosis do we get the gross manifestations; these children overcome the infection without ever showing signs of the process. That is why so many react to the von Pirquet test. I should like to ask Dr. Bruns why, if tuberculosis has nothing to do with phlyctenular disease, we get phlyctenulosis as a result when we give the cutaneous tuberculin test at times and also when we introduce it into the conjunctival sac. In Dr. Theobald's case in which tuberculosis was blamed for the knee condition, I think the mistake would not have been made if the practitioner had realized that these cases of congenital syphilis are especially susceptible to a superimposed tuberculous infection. I have had considerable experience with tuberculin in these cases during the past five years, and I feel very doubtful whether any patients have been much benefited by its use. Certainly if phlyctenular disease is a form of tuberculosis, it is an atypical form about which we do not know a great deal at the present. It has seemed impossible to cure some of the patients with severe cases of this disease until they have passed a certain age—15 or 17 years. In spite of all the care in the way of general hygiene with which we can surround them, they have recurring attacks; and although these attacks are diminished in number and milder in character, we have been unable to prevent them entirely.

DR. JOHN A. DONOVAN, Butte, Mont.: In our state school we used to have a great deal of this disease. For the last several years everybody admitted has had the adenoids removed and the children are put under different hygienic conditions from those at home, with the result that I have seen only one case of phlyctenule in three years. In my private practice no single remedy is so efficient to prevent recurrence as removing adenoids.

DR. H. D. BRUNS, New Orleans: I have not heard from the supporters of the theory of tuberculous etiology any argument strengthening, as it seems to me, their contention. All of those who have had most experience have found that it does not do to lay any stress whatever on a positive reaction to the skin test; but a negative reaction, especially in a young person, is the best evidence that the person is neither tuberculous nor liable to tuberculosis. There is one thing on which most of the physicians who live in the north lay stress which is not true in the south, where I live. Their cases occur wholly in children. Grown-up negroes, men 50 and 60 years of age, come into my clinic in New Orleans, afflicted with phlyctenules. I have seen big muscular roustabouts with phlyctenular ophthalmia, who certainly were not suffering with any form of tuberculosis known to clinical medicine. Most of the people I see who have phlyctenules are badly fed. They live on corn-bread and bacon with some kind of dry vegetable, beans or rice. The babies are weaned on bacon-rind instead of beer. The French clinicians who have of late been studying phlyctenular ophthalmia incline to divide these cases into two classes. Some are tuberculous and the disease is cured, they say, by the injection of tuberculin; some are non-tuberculous and can be cured by regulation of diet. In fact, some go so far as to specify that if certain articles of diet are withdrawn patients recover. I cannot refine so highly, but I always advise a diet of fresh meat and green vegetables with a good supply of fresh air.

REMOVAL OF THE LENS IN HIGH MYOPIA

WALTER EYRE LAMBERT, M.D.
NEW YORK

Although the surgical treatment of high myopia since its revival by Fukala in 1889 has been pretty generally practiced and recognized by most ophthalmologists as a justifiable proceeding, there is still a great difference of opinion as to its immediate and permanent value and its dangers. The recent text-books on ophthalmology do not very strongly advocate this operation; they emphasize the importance of employing it in only carefully selected cases, and even then they consider it somewhat dangerous.

Robert Hesse,[1] in an article reviewing the operations in Professor Dimmer's clinic since 1891 — in all sixty-seven eyes were treated — concludes that in only one case could any injurious effect be ascribed to the opera-

1. Hesse, R.: Abst. Ophthalmology, viii, 92.

tion — a case of infection. He considers the operation entirely justifiable.

Thompson[2] concludes that the growth of the long axis is not affected, that changes in the chorioid and vitreous opacities are contra-indications, and that it is doubtful if the second eye should ever be operated on — at any rate, not before a lapse of two years.

Geert[3] concludes that:

1. Axis lengthening in aphacic eyes remains progressive after operation.
2. Axis lengthening is as great in the operated eye as in the non-operated eye.
3. Vision in the operated eye remains constant in a smaller number of cases than in the non-operated eye.
4. The serious complications of high-grade myopia are more numerous in the operated eyes.
5. Operative complications enhance the chance of deleterious myopic changes.
6. The most favorable age is from 16 to 30.
7. The function of the retina sinks more in aphacic eyes than in non-operated eyes.

Most authorities are of the opinion that the age limit is about thirty years, and that the amount of myopia should be at least 16 D. I have done only nine operations on five patients, and while this is a rather limited experience, the results have been so uniformly satisfactory that I may be more optimistic than those who have had a wider experience, and therefore some failures.

Two of the cases included in this paper have already been reported in the *Transactions of the American Ophthalmological Society* in 1907. The immediate results in these cases were brilliant, particularly in the second in which the fundus changes were most extensive and vitreous opacities also were present. I am still in touch with these patients and know that the good vision has been maintained.

CASE 1.—A girl, aged 16, first seen in May, 1906, had 21 D of myopia in the right eye and 16 D in the left; vision in each eye with the correction was 20/70. The fundi, except for large staphylomata, were in a very healthy condition. Fukala's method was used, the lens in the first eye being removed by linear extraction forty-eight hours after needling; the lens of the second eye was treated in the same manner. After discission of the capsules the vision for the right eye was 20/30 with + 1.50 cy. 90; for the left eye, 20/30 with + 1.50 s + 1.50 cy. 90, with + 3.00 added for near. This patient has pursued her vocation as a stenographer, and when I saw her last her vision was practically 20/20 for each eye.

CASE 2.—A woman, aged 31, first seen in October, 1904, was kept under observation until October, 1906, when the first operation was performed. Her vision for the right eye was 20/200 with —22.00; for left eye, 20/100 with —20.00. There were extensive changes in the fundus, commencing changes in the lens, and floating vitreous opacities. This case was treated in a manner similar to the first, save that three needlings were required in one eye and four in the other before the linear extraction could be made. Recovery was uneventful. Discission of the capsule was made, resulting in vision of 20/30 with —2.00 cy. 90 for the right eye and 20/30 with —1.50 s + 2.50 cy. 165 for the left eye; with 3 s added she read Jaeger 1. This vision has been maintained up to the present time, and the patient, while being careful of her eyes, reads and sews with great comfort.

CASE 3.—A woman, aged 26, had always been short-sighted. The shadow test showed a myopia of 22 D for the right eye and 21 D for the left with an astigmatism of 1° against the rule in both eyes; the vision was 20/70 with this correction. There were floating opacities in the vitreous, especially in the right eye, and large staphylomata, with a general atrophic chorioiditis. Two needlings were required for each eye and were made at intervals of about three days. A linear extraction in each eye was followed by a discission of the capsule with the DeWecker scissors, resulting in a vision of 20/40 for the right eye with —.50 s +2 cy. 90 and 20/40 for the left eye with +2 cy. 165; an additional +2.50 s enabled the patient to read and sew with comfort. There were no unfavorable symptoms at any time during the treatment. The final operation was done in October, 1910, and I saw the patient last in March, 1912; at that time the vision was the same, 20/40 for both eyes, and the floating opacities had cleared to a large extent. I may add that her vision is almost as good without her glasses as with them and she frequently dispenses with them save for close work.

CASE 4.—A woman, aged 50, gave a history of short-sightedness all her life. She was referred to me in January, 1910, by a colleague who desired an opinion as to the wisdom of an operation. Her vision had been failing rapidly, owing, apparently, to opacities in both lenses which were so dense at that time that only a very poor view of the fundus was obtainable. Her vision was reduced to little more than counting figures. My colleague informed me that there were vitreous opacities in both eyes, extensive chorioidal changes and a myopia of from 20 to 22 D. I advised a preliminary iridectomy with a subsequent extraction. The patient then disappeared and we neither saw nor heard of her until early in the spring of 1911, when she called on my colleague and was again referred to me with the request that if it still seemed wise I proceed with the operation. I therefore made a preliminary iridectomy on both eyes on April 11, 1911, extracting the lens of the left eye on May 3. There was considerable soft lens matter which irrigation with normal salt solution failed to remove entirely; that which remained was gradually absorbed, leaving a dense, opaque capsule. On June 12 a discission was made with the DeWecker scissors. I was then obliged to leave the patient in the care of my assistant and I did not see her again until November. The opening in the capsule was still insufficient and a second discission was made with entirely satisfactory results, her vision being 20/50 with —1.00 s —3 cy. 90.

On account of the soft lens matter in the first eye I decided to needle the second cataract before attempting its extraction, hoping thus to shorten the process. The eye was needled on November 10, 12 and 17. Two days after the last needling the lens was quite swollen, the anterior chamber shallow, the tension slightly elevated, and immediate extraction was indicated. Unfortunately, the patient suddenly developed a severe mucopurulent conjunctivitis which yielded after five days to treatment by irrigation of nitrate of silver, 1/20 of a grain to the ounce. No alarming symptoms, such as increased tension, etc., developed during this time, and the lens was extracted with no complications; the anterior chamber was irrigated with normal salt solution and all the soft lens matter apparently removed. A few days later, however, it was seen that a rather large amount remained, which was gradually absorbed, leaving only the capsule. A discission of the capsule is yet to be made, and we hope that fairly good vision will be obtained.

CASE 5.—A woman, aged 27, complained that her sight had gradually grown poorer for some time past. Skiascopy showed a myopia of about 28 D for both eyes. The media was clear and the fundus of each eye in good condition except for large posterior staphylomata. Vision for both eyes was 20/70 with —27.00. The lens of the left eye was needled on Nov. 15, 1911, with practically no reaction and very little effect; five days later it was needled again with no reaction. A third needling was made November 24, and on the 29th a linear extraction was made. When the patient was discharged from the hospital on December 7 the eye was perfectly quiet but there was a good deal of soft lens matter remaining. Atropin, dionin and hot bathing were used, the lens matter being absorbed very slowly. On Jan. 30, 1912, an opening in the capsule was made with a Ziegler knife, resulting in vision of 20/70 with —2.00 cy. 115. March 14, she read 20/50 with this correction, which vision I have no doubt can be greatly

2. Thompson, A. H.: Brit. Med. Jour., Oct. 29, 1910, p. 1321.
3. Geert, C.: Ophthalmology, vii, 674.

improved, as the opening in the capsule is not satisfactory and another needling will have to be done.

My experience in these cases is that the age of the patient is not a contra-indication to this operation. The Fukala method, that is, needling of the lens followed by a linear extraction, is the best, in all young subjects at least. If the patient is 50 or over, and the lens is more or less cataractous, a preliminary iridectomy with subsequent extraction in the usual way would seem to be the wisest course. It is important that the patient be kept under close observation during the entire course of treatment in order that any unexpected complications may be promptly dealt with. I do not regard extensive fundus changes with vitreous opacities, provided that no active inflammatory process is going on, as contra-indicative of operation, and this was proved, in three of the cases reported, by the remarkable vision obtained, notwithstanding the presence of vitreous opacities and extensive chorioidal changes.

Of the danger of detachment of the retina following this operation these cases can prove nothing, as none of them have been under observation quite long enough; I cannot see, however, why it should be any more likely to occur than if the operation had not been performed.

It will be seen from the report of these cases that the younger the patient the fewer the needlings required; in Case 2, that of the young girl, only one was necessary, while in the other and older patients from two to four were required.

In all these cases the patients have been more than satisfied with the results, and they have been able to carry on their work and to enjoy life as they could never have done without this operative interference.

47 West Thirty-Eighth Street.

ABSTRACT OF DISCUSSION

DR. PETER A. CALLAN, New York: High myopia is rare in this country as compared with Germany, France and Russia. To my mind, the operation is perfectly justifiable in young people under 30 or possibly 35. As to the dangers of infection, of course, that holds good for all operative procedures for opening the eyeball, but it is growing less and less all the time when we are more careful. The other great danger is the detachment of the retina. My private belief is that possibly a few more cases occur after the removal of a clear lens than would occur otherwise in these high myopic cases, but if we examine the statistics the percentage in these operated cases is very little greater than in other cases. Bjerke, in 1902, collected reports of 1,176 cases, with operations by twenty-five surgeons, mostly German, French and Austrian. He found 4.85 per cent. of detachment of the retina in these operations. The methods were various. Discissions with linear extraction were the most numerous. As to the results, Schweigger had fifty cases in which he operated by discission and linear extraction with 14 per cent. of detached retinas as a result. Von Hippel with 184 cases by the same method had 5 per cent. Thus, it is not altogether the method to which the failures are due in the reported cases as done abroad. Very few are willing to depend on simple discission. I have had, all told, about fifteen cases. I have operated in four cases on both eyes at the request of the patients, who were well satisfied with the result. I do not think one is justified in operating on the second eye until the patient fully realizes the danger he runs, infection, detachment of the retina, etc. Von Hippel collected a number of cases in which he compared the cases of patients operated and not operated on. He found in the latter that 6.7 per cent. had detachment of the retina. The operated cases had only 5.4 per cent. Fraelich collected a large number and he found in the operative cases 3.3 per cent. of detachment, whereas in the non-operative cases he found 2.2 per cent. If anybody has doubt in his mind about the operation he should in the young do a discission which will take a longer time but that is of small account. What is a year or eighteen months when the whole future of the eye is involved?

DR. S. D. RISLEY, Philadelphia: I have many times in the past in this Section opposed the extraction of the transparent lens in high myopia on purely theoretic grounds; that is to say, because of the well-known pathologic conditions of the fundus in highly myopic eyes. I am still opposed to such operation so long as the myopia is progressive. But of late years the question has presented other features. For example, I have had slowly accumulating in my office a considerable number of reports of cases of high myopia which for many years had been under observation and treatment. The pathologic conditions had subsided; the myopia was no longer increasing; there were no additional chorioidal atrophies; the eyes, barring the scars of former disease, were well. But in quite a number of these patients I have seen other things transpire. There was increased impairment of vision, without notable pathologic change in the fundus, due to changes in the crystalline lens. The image of the fundus details, as seen with the ophthalmoscope, was distorted; the lens was amber-colored or opalescent and was apparently undergoing contraction changes, which caused the increasing impairment of vision and a corresponding increase in the helplessness on the part of the patient. Since this was not due to pathologic changes in the fundus, I have in several of these myopic patients, during the last five or six years, advised the extraction of the lens and the results have proved that the advice was justifiable. One case has interested me very much. The patient, aged 62, had been under my direct observation since 1886. She had large patches of chorioidal atrophies including the macula in both eyes so that the central vision was gone, but the periphery of the fundus was healthy and the fields were good. She was steadily becoming more helpless. She had a myopia of 22 D. in one eye and 18 D. in the other. I explained the situation to her and advised extraction of the lens, to which she very promptly consented. A preliminary iridectomy was performed and a few weeks later the lens was extracted. A capsulotomy proved to be necessary as a final procedure. The patient was so well pleased with the result that she returned in three months and begged me to operate on the other eye which I did with equally good results. I have had four experiences with eyes which I had been watching and treating for a long period of years; but at the time of operation they were well eyes. I am still opposed to incurring the dangers which are inevitable in eyes of patients under 35 years of age with a transparent lens, progressive myopia and the pathologic chorioidal disease still present.

DR. H. D. BRUNS, New Orleans: We, in this country, see so few cases of high myopia that it seems to me we ought to report our experiences with this operation. I have operated about eight or ten times and my experience makes me think that in his late book on the treatment of myopia, Hirschberg has reassembled the exact indications for the operation. It ought not to be undertaken unless there is about 15 or 16 D. of myopia. It should be done in people not over 20, unless for special reasons. I believe this is important because the operation that offers by far the greater chances of successful result is the operation by repeated discissions. It is long, it is trying on the patient and on the surgeon, but its safety is undoubtedly very much greater than the attempt to extract the lens from a myopic eye. By explanation to the patient that the process is going to be a long one, that neither the patient nor the surgeon must take the question of time into consideration, a satisfactory understanding will be reached. I have had the good fortune to watch three of these cases over a considerable period of time, one case for three years; a woman of about 22, on whom I operated because there was constant pain in the myopic eye. The other eye was good. The patient complained so much of this pain that after full explanation I removed the lens, with entire relief of the pain. I saw the patient about three years afterward; the eye was in good condition. The other two patients I watched for five and eight years, respectively. In both cases the patient returned and requested operation on the second eye and both

were operated on. One patient I saw recently; the eyes are still in good condition and the vision is as good as it was a short time after the operation. That was true of the other case. It seems to me, considering the helpless condition of these people, that we should attempt to help them. The operation is to be undertaken only after we are sure that the eyes are free from active disease, and highly myopic and that the patient has poor prospects for a livelihood; it is therefore especially demanded in those unfortunates whom we see in hospital practice. In such cases it is an entirely justifiable operation and a beneficial one.

DR. LINN EMERSON, Orange, N. J.: Relative to operating on the second eye, my patient was a housemaid who recently came to this country and could not get about the streets without being led. She had 26 D. of myopia. I operated on the first eye and with a +2 cylinder she had 20/70 vision. She came back and I operated on the second eye without fully explaining things to her. On the whole the result in the second eye was equally good, but for the next two years that girl was the bane of my life, because I could not satisfactorily explain to her why she could not read a newspaper, and could not peel potatoes, or do similar work. I will never again do an operation on the second eye until I have fully explained the probable result to the patient.

DR. WILLIAM H. BATES, New York: I agree that this operation is justifiable in certain cases. I can recall one patient operated on fifteen years ago in whom the operation on one eye was satisfactory, but the patient did not come back to have the other eye operated on. I saw a patient last winter with a myopia of 20 D. in each eye and a vision of about 10/200. She had great difficulty in doing her work and in getting around and was anxious for any relief that could be given. I advised removal of the lenses. I gave preliminary general treatment which included large quantities of water to drink and some atropin. I tested the patient's refraction when she was looking at the 10/200 line with the retinoscope and it agreed with the glass that she accepted. I had her hold up some fine print with the glasses; at about 6 inches she was not able to read it. I told her to make an effort to read this fine print at 6 inches, and while she was doing it (by simultaneous retinoscopy), her myopia was a great deal less, and afterward when she looked at the card the vision was better than 10/200. It had gone up to 10/100. I had her repeat the exercise until now her vision is 20/40 with 20 D. She said "Doctor, you have done me a lot of good, but when are you going to operate?"

DR. FRANCIS VALK, New York: It may be regarded as heresy, but I do not believe that myopia is always due to an elongation of the optic axis; this implies that we have two kinds of myopia, one kind due to elongation of the axis and one due to the curve of the cornea. That brings up the question whether we should operate in these cases. If we have a myopia of 20 D., as Dr. Risley's case, with macula chorioiditis, we operate successfully because it is a case of refractive myopia. Such patients do well. On the other hand, if we have a case of myopia in which we have a long radius of curvature, and there is a posterior chorioiditis, then it is simply a matter of choice whether you operate or not.

DR. WALTER E. LAMBERT, New York: The greatest discretion and conservatism should be observed in these cases, but there comes a time when the patients demand relief. They are practically blind and constantly growing worse, and even though extensive fundus changes exist, and vitreous opacities, the opposition is, in my judgment based on my experience, justifiable and advisable.

NORMAL VALUES OF THE ACCOMMODATION AT ALL AGES

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NEW YORK

Three years ago I presented a report to the Association,[1] giving measurements of the accommodation in some six hundred subjects of all ages, and deducing from these measurements a revision of the standards which Donders had established for the progress of presbyopia and which for fifty years had been universally accepted. After the paper was published, its results were adopted by various authorities[2] as a substitute for those of Donders.

Since then my researches have been carried on continuously. A number of new cases have been added, and the findings in some of the old cases have been revised. In all, nearly 1,500 subjects have been examined, and out of these considerably over 1,000 have been utilized. The results thus obtained are now presented.

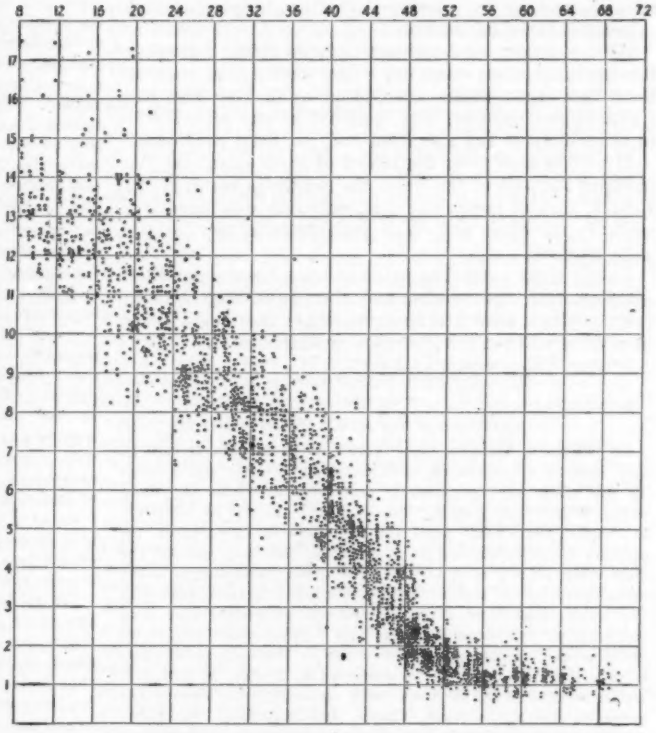


Fig. 1.—The accommodation at different ages. Each dot represents the maximum accommodative power of an individual eye at a given age, the figures on the side of the chart denoting the accommodation in D, the figures at the top denoting the age. The accommodation was determined by rendering the patient emmetropic and measuring the distance of his near point from the anterior focus of the eye, i. e., from a point 13 mm. in front of the cornea. This, of course, gives higher values for the accommodation than if the measurement is made, as is generally done, from the cornea itself.

The details of the method pursued in making the investigation were fully described in the previous paper, and will not be repeated here. Suffice it to say, that each subject was first rendered fully emmetropic by

1. Duane, A.: The Accommodation and Donders' Curve and the Need of Revising Our Ideas Regarding Them, THE JOURNAL A. M. A., June 19, 1909, p. 1992.
2. Fuchs: Lehrbuch der Augenheilkunde, Ed. 12. Weeks: Diseases of the Eye. Percival: The Prescribing of Spectacles.

glasses and his accommodation was then carefully and, wherever possible, repeatedly measured, due regard being had always to the conditions under which such a test should be made.[3] The value thus found for the accommodation was expressed in dioptries and plotted in a chart. Figure 1, in which each dot represents the accommodation of a single eye at a given age, shows how this was done. The aggregate of dots forms a sort of galaxy, which exhibits a very characteristic and quite regular curve. The great mass of the dots are included between the limits of the curves *AA* and *BB* (Fig. 2), and for the most part between the curves *AA* and *CC*.

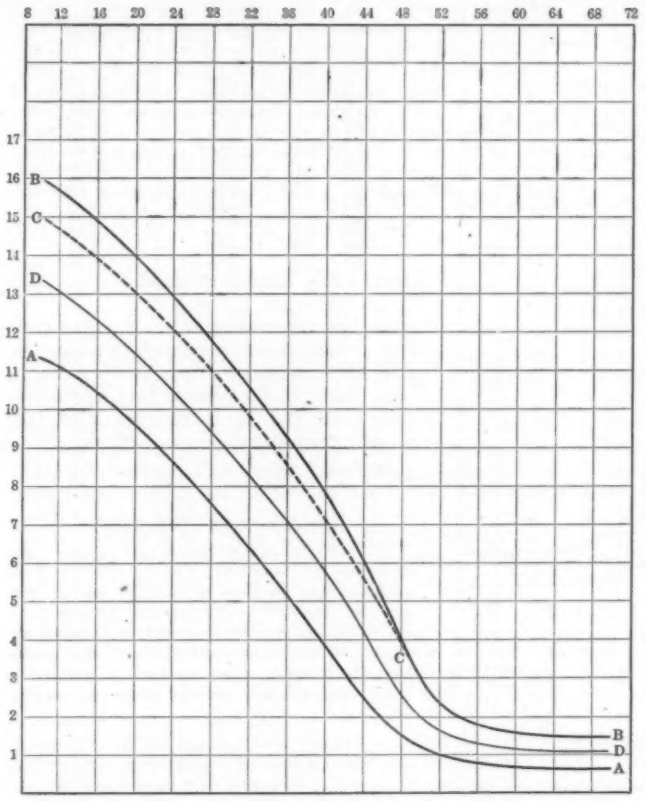


Fig. 2.—Limits of the accommodations in normal cases. The vast majority of the dots represented in Figure 1 are included between the curves AA and BB, and for the most part between AA and CC. These, therefore, represent the lower and upper limits of normal cases. Cases lying below AA are subnormal and above BB supernormal. The rate of descent of the accommodation in persons with high accommodative power is shown in BB and the less rapid descent in those of low accommodative power is shown in AA. DD is the "mean curve" representing the rate of descent of what may be called an average case.

These, therefore, are the upper and lower limits for normal cases. Values lying below *AA* must be regarded as subnormal and those above *BB* as supernormal, or in many cases doubtless as representing errors of measurement.[4]

Line *DD* (Fig. 2) represents what we may call the mean curve of accommodation, inasmuch as it passes in general through the densest portions of the mass of dots and indicates thus the core of the galaxy. The term "mean curve," however, has very little significance. Its position is more or less arbitrary, and other observers, using the same data as we, might doubtless give the mean curve a different placing, although in no case probably would the difference amount to over 0.5 D. After all, however, what we wish to know in any given case is whether the accommodation found lies well within the normal limits, i. e., between *AA* and *BB* (or *CC*). Whether it lies close to *DD* or not is, comparatively speaking, a matter of indifference. Indeed, the chief and perhaps the only significance that attaches to *DD* is that it gives the rate of fall of accommodation, i. e., the recession of the near point, in what may be called the average case. This rate, both in the average and in the extreme cases is shown numerically in Tables 1 and 2, given below. From these tables as well as from Figure 2, it is obvious that an accommodation which normally lies near the upper limit given, i. e., near *BB*, will fall off faster, and one that lies near the lower limit, *AA*, will fall off more slowly than the average, represented by *DD*.

It may be asked how near we are to certainty in these matters. In other words, how sure are we that the curves given do represent the normal limits and the normal rate of change of the accommodation from year to year? We think we may say we are fairly sure. When the investigation was begun, and the observations were comparatively few, the limits found at different times varied widely, and the results were obviously open to suspicion.[5] As observations multiplied, the results became more and more concordant. This is shown, for example, in Figure 3, where the curves, as found three years ago, are compared with the curves now regarded as best established. As will be seen, the main result of completer investigation has been, first, to eliminate the sinuosities and irregularities of the previous curves; second, to diminish somewhat the upper limit before the age of 25; and, lastly, to expand both the upper and lower limits after the age of 40. The change last named, which is the only one really of importance, seems to be quite well substantiated, inasmuch as the number of good observations for the decen-

3. Especially as regards illumination, the character of the test-object, the patient's condition, etc. In all the later series of cases the test-object used was my accommodation disk described in the Ophthalmic Record, August, 1909. This consists of an engraved black line, 0.15 mm. in diameter, bisecting a small white parallelogram which is mounted on a disk of black velvet. To render the patient strictly emmetropic he was supplied with the glass correcting his total refractive error, which glass for patients under 48 was determined with the aid of homatropin. When the near point was either too far or too near to be accurately measured, a suitable convex or concave lens was added to the correction, and a corresponding addition or deduction made in the finding. For particulars see original paper.

4. The convincing character of the curves AA and BB is heightened if we include a number of cases which I felt bound to reject, yet which can hardly be classed as abnormal. Such, for example, were cases in which the measurements at different times varied so widely that one could not know just what value to assign to the accommodation. Such, too, were cases in which the measurements taken at any one time were consistent but in which examination a year or more later gave higher values, showing that the first results were below the normal of the individuals concerned. The findings in both classes of cases were rejected. Yet with few exceptions they lay within the limits here assigned, and might perhaps have been included as representing simply normal variations.

5. Thus particularly the approximate results published in the New York State Journal of Medicine, July, 1908, and in Tr. Am. Ophth. Soc., 1908.

nium between 40 and 50 is particularly large. The normal limits of the accommodation, therefore, in beginning presbyopia are apparently wider than had been supposed. But even in this case, the change, though important, is not great in amount. The other changes are comparatively trifling, and in the case of the mean curve the two sets of observations agree very closely indeed. Moreover, we seem now to have reached the point, where the addition of each hundred cases makes no appreciable difference in the results. Since these results are based on many hundred cases, and on a method consistently carried out for a period of five years with rigorous regard to the conditions that should obtain in such an investigation, and since, moreover, they have reached a point where they no longer vary as observations multiply, it is believed that they actually represent the normal values.

139 East Thirty-Seventh Street.

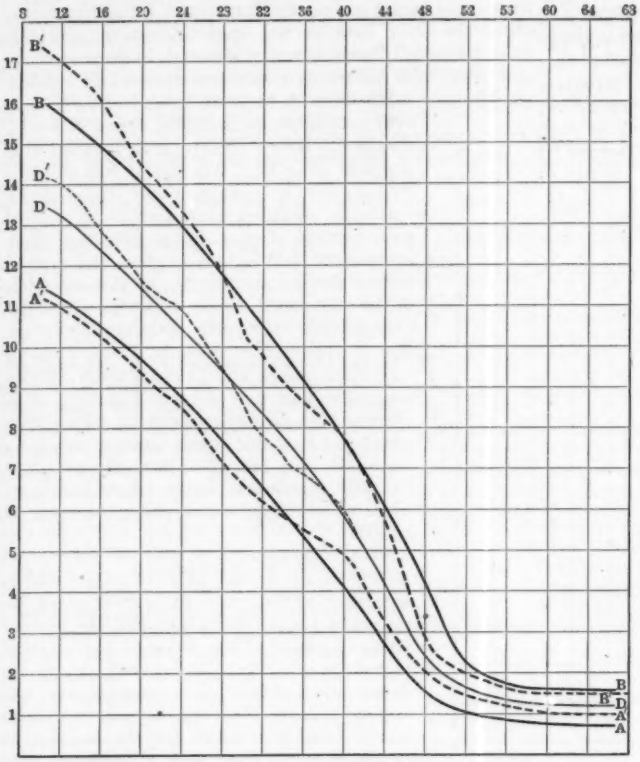


Fig. 3.—Comparison of early and final results. AA, BB and DD, as in Figure 2; A′A′, B′B′ and C′C′, corresponding curves found three years ago. Note the more regular course of AA, BB and DD and the fact that in them the upper limit is lower before the age of 25, while after the age of 40 the upper limit is higher and the lower limit lower than previously found.

TABLE 2.—APPROXIMATE VALUES OF ACCOMMODATION AT EACH FOUR-YEAR INTERVAL

Accommodation is given in D (to the nearest 0.25 D), near point being measured from the anterior focus of the eye, i. e., from a point 13 mm. in front of the cornea.

Age	Lower Limit in Normal Cases	Usual Upper Limit
8	11.50	15.50
12	11.00	15.00
16	10.50	14.00
20	9.50	13.00
24	8.50	12.00
28	7.50	11.00
32	6.50	10.00
36	5.25	8.50
40	4.00	7.00
44	2.50	5.50
48	1.50	4.00
52	1.00	2.25
56	0.75	1.75
60	0.75	1.50

ABSTRACT OF DISCUSSION

DR. S. D. RISLEY, Philadelphia: I have been impressed by clinical experience with the almost mathematical precision with which we can predict the range of accommodation for any given age in emmetropic eyes, or in eyes in which the ametropia has been corrected and the glasses have been worn for considerable periods of time. Dr. Duane's careful laboratory studies

TABLE 1.—NORMAL VALUES OF THE ACCOMMODATIVE POWER AT ALL AGES FROM 8 TO 68

Accommodation is given in D and tenths, near point being measured from the anterior focus of the eye, i. e., from a point 13 mm. in front of the cornea.

Age	Lower Limit in Normal Cases	Mean Value	Usual Upper Limit	Extreme Upper Limit
8	11.7	13.8	15.4	16.4
9	11.6	13.6	15.2	16.2
10	11.4	13.4	15.0	16.0
11	11.2	13.3	14.9	15.8
12	11.1	13.1	14.7	15.6
13	10.9	12.9	14.5	15.4
14	10.8	12.7	14.3	15.3
15	10.7	12.6	14.1	15.2
16	10.5	12.4	13.9	14.9
17	10.3	12.2	13.7	14.6
18	10.1	11.9	13.5	14.4
19	9.9	11.7	13.2	14.2
20	9.7	11.5	13.0	14.0
21	9.4	11.2	12.8	13.7
22	9.2	10.9	12.6	13.5
23	8.9	10.6	12.3	13.2
24	8.7	10.4	12.1	13.0
25	8.4	10.2	11.8	12.7
26	8.2	9.9	11.6	12.4
27	7.9	9.6	11.3	12.1
28	7.6	9.4	11.1	11.8
29	7.3	9.2	10.7	11.5
30	7.1	8.9	10.4	11.2
31	6.7	8.6	10.2	10.8
32	6.4	8.3	9.9	10.5
33	6.1	8.0	9.6	10.2
34	5.9	7.7	9.2	9.9
35	5.6	7.3	8.9	9.6
36	5.3	7.1	8.6	9.4
37	4.9	6.8	8.2	8.9
38	4.6	6.5	7.9	8.6
39	4.3	6.2	7.6	8.2
40	4.0	5.9	7.2	7.8
41	3.6	5.4	6.8	7.5
42	3.2	5.0	6.4	7.0
43	2.8	4.6	5.9	6.5
44	2.5	4.2	5.5	6.1
45	2.2	3.7	5.2	5.6
46	1.9	3.3	4.8	5.1
47	1.7	2.8	4.3	4.5
48	1.5	2.5	3.9	4.0
49	1.3	2.2	3.4	3.4
50	1.2	2.0	3.0	3.0
51	1.1	1.8	2.6	2.6
52	1.0	1.6	2.3	2.3
53	0.9	1.5	2.1	2.1
54	0.9	1.4	2.0	2.0
55	0.8	1.3	1.9	1.9
56	0.8	1.2	1.8	1.8
57	0.8	1.2	1.7	1.7
58	0.7	1.2	1.7	1.7
59	0.7	1.1	1.6	1.6
60 to 68	0.7	1.1	1.5	1.5

in large numbers of eyes have verified the correctness of our daily findings in the routine work of the clinic and consulting room. I find that his paper agrees closely, not only with the early work of Donders, but with a series of observations I made to determine the normal near point, in order to verify my studies of the duration of the cycloplegia produced by the several mydriatics. The object employed was a series of fine wires stretched across a circle with an illuminated ground-glass background. For such determination I found it important to confine the study to emmetropic eyes, or to eyes in which correcting glasses had been worn for a long time, since quite different results were reached in eyes which were struggling to maintain binocular vision in the presence of abnormalities of binocular balance or errors of refraction of different degree in the two eyes.

DR. E. E. HOLT, Portland, Me.: It occurred to me when Dr. Risley mentioned how constantly the accommodation of the eyes, as found in our daily practice, corresponded to the scientific standard of measurement, that I had been able in quite a number of cases to determine the age of women who declined to give it in years but would give the day and month of the year. After determining the ametropia and the accommodation, I would say to such a patient, "You were born on such a day and year, and are, therefore, so old." The patient would say, "Why, how did you know my age?" and I would reply, "By examining your eyes."

MORGAGNIAN CATARACT *

BURTON CHANCE, M.D.
PHILADELPHIA

Morgagnian cataracts are not of very common occurrence and, among the younger generation of surgeons, have excited but little interest. Indeed, since 1890, no case has been presented to this Section; I find no report of any in the transactions of the American Ophthalmological Society, and Taylor,[1] in reporting a case before the Ophthalmological Society of the United Kingdom, says that for thirty years past not a single instance had been brought before that society. Pathologically, they cannot be rare, and, in the past, my masters spoke of them with interest, as though they had frequently seen them. It may be that now they are not common, clinically. Perhaps it is that we are consulted earlier than the older men were, so that the cataracts we see are firmer; or more probably, we are not consulted at all by those in whom extreme hypermaturity is present, whose cases we read of in startling headlines in the public prints declaring the cures of cataract by natural processes after the greatest surgeons had insisted that only operations could relieve. However this may be, references to them in the past ten years are few in number, and I can recall only four or five instances of hypermature cataracts marked by so great a liquefaction as to characterize them "Morgagnian."

It is therefore with a great deal of enthusiasm that I mention that recently, in the space of six months, I operated on two patients, and I cannot avoid recalling with peculiar interest the attitude of uncertainty and hesitation which certain of my elders manifested toward one of the cases, when I presented it for study before a clinical society.

Morgagnian cataracts are usually monocular and, as is most evident, occur in long-standing cases, that is, one eye becomes cataractous in middle age and the patient becomes reconciled to the inconvenience attending it and does not seek advice until the onset of cataractous symptoms in the other eye. Such cataracts sometimes follow serous cyclitis and in some of the cases more or less extensive degenerative changes have taken place in the chorioidoretinal tunics, though this, of course, cannot be seen until after the extraction of the opaque lens. Other cases have been those of congenital total cataracts. Cataracts, even at birth, may be so disintegrated as to present softening of the cortex with the harder center which has sunk to the bottom of the capsule; or they may be completely fluid with the absorption of the imperfect nucleus. Such cases can hardly be considered as having ever been mature; on the contrary, they have been caused by a failure in the development of the lens, the fibers of which have been replaced by an opaque albuminous fluid. Yet clinically, as Treacher Collins[2] pointed out, in 1908, they are entirely comparable to the Morgagnian cataracts of adult life. I have not seen a Morgagnian cataract produced by accidental injuries, or after incomplete needling in the case of complete congenital cataracts.

In Morgagnian cataracts in old lenses the cortex liquefies, becomes milky white in appearance and the substance homogeneous. In the lower portion there is present a semicircular, dark, or brownish shadow cast by the upper half of the dense nucleus which has sunk to the bottom of the lenticular sac. The brownish shadow can be seen to change its position as the position of the nucleus is altered by the movements of the head, and, when the pupil is dilated, the difference in the color of the reflex may readily be noted—it is yellowish when the patient is standing up and milky white when he is lying down. It is not always possible to distinguish the nucleus, because its outlines may be hidden by the opaque cortical, which, as is well known, can be denser and more impervious to light than a hardened lens.

It may be of interest to consider the genesis of the Morgagnian cataract. It comprises the metamorphosis of a mature cataract into a state of liquefaction, and it is probable that the changes are truly inflammatory in type. The epithelium proliferates and we have a thickening of the capsule which retains the water of disintegration in which the cortical mass is dissolved, or, the cortical lens substance is gradually absorbed and is partially replaced by fluid to such an extent that the nucleus moves about in it and gravitates to the lowest point within the capsular sac. The fluid cortical substance may remain yellowish or become entirely opaque, whitish or murky. The nucleus remains unaltered or shows only an eroded surface due to a slight absorption of its susbtance, and it may contain Morgagnian droplets and cholesterin crystals, as in Claiborne's[3] case and in my own. The capsule may rupture and allow the nucleus to escape through the rent into the anterior chamber, as happened in Ewing's[4] case.

It is rather curious that Morgagni[5] himself attributed the formation of cataract to a process the very reverse of this. He believed that a "humor" existed in the healthy state, between the capsule and lens, and that it was this humor which became opaque and formed the impediment to vision, or, "verily that the secretion of this humor having been stopped, the crystalline lens became dry and opaque."

There are many ways in which the obstruction caused by cataract may be removed by the processes of Nature. If the patient lives long enough, the lens may so far liquefy and become absorbed as to leave only a small

* Read in the Section on Ophthalmology of the American Medical Association, at the Sixty-Third Annual Session, held at Atlantic City, June, 1912.

1. Taylor: Tr. Ophth. Soc. U. Kingdom, xxxi, 146.

2. Collins, E. T.: Developmental Deformities of the Crystalline Lens, THE JOURNAL A. M. A., Sept. 26, 1908, p. 1051.

3. Claiborne: Arch. Ophth., 1909, p. 513.

4. Ewing: Am. Jour. Ophth., 1909, p. 328.

5. Morgagni: Quoted from Dixons' Guide to Dis. of Eye, Ed. 2, 1859, p. 230.

remnant within the capsule, or the capsule itself may be absorbed. Sometimes the lens may be dislocated and without harm sink into the vitreous humor, thus effecting the restoration of sight to ardent devotees on pilgrimage to famous curative shrines. In my notes of unusual cases observed while resident at the Wills Hospital in 1894, I find one relating to the extraction of a hypermature cataract:

"Surgeon R., when about to lay down his knife at the completion of the incision, was startled to see the lens ejected from the eye through the wound and light on the pillow some distance from the patient's head. The lens resembled a large white pearl, but after a few oscillations the capsule ruptured and a milky fluid ran out leaving a dense nucleus within the folds of the capsule. This extraordinary occurrence was followed by an uneventful recovery."

Sometimes the fluid is completely transparent and the nucleus may fall below the pupil sufficiently to allow the vision to be corrected by an appropriate lens, as in a case reported by von Reuss.[6] In others, the capsule has remained more or less transparent, so that the sight has even improved. In a case reported by Calderaro,[7] the absorptive processes must have progressed far, for the fluid surrounding the nucleus was entirely transparent, and, on microscopic examination, the lining cells of the capsule were completely lacking.

REPORT OF CASES

The cases I desire to record are as follows:

CASE 1.—The patient, a woman, aged 73, of unusual vivacity, a native of Ireland, but long resident in this country, became suddenly blind in her right eye at the age of 55, but fearing that she had a cataract did not consult an oculist. In October, 1910, when the sight began to fail in the other eye, she came to me. She had been in perfect health for one of her years, with jet-black hair and was quite self-sustaining. She had never had any inflammatory disease in either eye; the visual acuity of the left eye equaled 5/10, but that of the right was equal to light perception only.

The corneas and irises were healthy but the lenses were cataractous. The right lens was particularly remarkable. The fundus was obscured by a dense milky-white opacity occupying the pupillary space. It was granular and without formal structure; it seemed to be solid or like a fluid compactly retained by the capsule. The globe was at normal tension, the anterior chamber somewhat shallower than that of its fellow. When the pupil was dilated the crystalline lens presented a striking picture. In the lower quarter lay a deep mahogany-colored body, thought to be the nucleus, which slowly changed its position, but in a definite way. The shape was a flattened ellipse which maintained a more or less vertical balance, and would float upward until the convex border appeared well within the pupillary space. The nucleus had a sharply outlined contour; it was very much smaller than any senile nucleus I had ever seen, and in its substance it contained a number of bubbles or Morgagnian globules.

When I exhibited the patient at the meeting of the Wills Hospital Society, much interest was taken in her case and elements of uncertainty in the diagnosis were discussed. This seemed rather extraordinary, for in my private study of the case, the appearance was exactly like that which Fuchs so masterfully describes in his text-book.[8] While the patient maintained the erect posture, the nucleus fell forward in the sac, yet was entirely surrounded by the fluid, the density of which prevented easy movement and held the nucleus upright. This appearance, after a few moments' steadying, was quite changed by rapid movements of the head and of the globe. The nucleus would sink below the pupil border so that the changes were quite misleading; so much so that one distinguished visitor did not hesitate to regard the case as one of "black cataract," dependent on deep-seated inflammatory disease. It was determined, however, to extract the lens. On the day of the operation the patient had been kept in bed for several hours. It is needless to say that there was no sign of the nucleus when I approached her bedside. It reappeared when she was made to sit up for a few moments.

During the incision the tension of the globe fell, so that it was not possible to make a perfect linear incision; the knife was brought out too high to enable me to make a satisfactory iridectomy. It was my intention to attempt the extraction of the entire capsulary body, and a loop or vectis was inserted well behind the cyst-like body which flopped and wobbled, so that it was difficult to engage it and just as the cyst entered the wound, the capsule ruptured and the anterior chamber was flooded with the opaque fluid. After this collapse it was easy to reintroduce the loop and to engage and withdraw the nucleus, but as the hyaloid had been lacerated no further attempt was made to withdraw the capsule. A thin film of vitreous and a rather large air-bubble mixed with the cortical fluid. The toilet was performed without further accident and atropin was instilled. A roller bandage was applied. I was assisted in the operation by Dr. William Zentmayer, to whose kindly help I owe my success. The patient behaved with the utmost composure throughout the rather lengthy ordeal, but later she became restless and quite wilful, with lack of control. In spite of this, however, in two days the wound became firmly closed. On the ninth day there began a sharp attack of iridocyclitis which lasted for four weeks, accompanied by headaches and deep pain in the globe. It is not at all unlikely that the iridocyclitis was caused by the swelling of some of the cortical debris which was left behind in the aqueous chamber, although a large quantity gushed out at the time of the operation. Notwithstanding these symptoms the aqueous in time became perfectly clear and at the end of the sixth week the patient returned to her home. The eye was then quiet; there was a small coloboma, the pupil being spanned by a dense capsular sheet studded with brownish pigment masses, and in the upper outer angle there was a circular rent. The patient returned to the hospital as I was leaving for a voyage to Europe and Dr. Schwenk incised the capsule and later extracted the other cataract with most favorable results. Considering the length of time since the cataract had begun to form and the degree of dissolution of the cortex, the nucleus showed a marked resistance to the processes of disintegration. It measured approximately 3 by 5 mm., was of a most pronounced lenticular form, of a dark mahogany color and exceedingly dense and firm, except for two or three vacuoles rather deep in the substance. On section the fibers were quite condensed except here and there where they were separated, the intervening spaces being filled with a granular coagulated fluid.

CASE 2.—The patient was a healthy and florid woman of 60, of large frame and the general physique of the natives of Western Pennsylvania. She had had symptoms of cataract for fifteen years. The history is quite confused. For reasons which she could not recall, she had consulted an irregular practitioner, who, from time to time, at each of her visits to his office, did what he told her was "needling." A month or so before she consulted me, March, 1911, her left eye had been painfully inflamed. The sight of the right eye had always been good, but that of the left gave her only shadows. The left globe was deeply congested in the ciliary and scleral regions, yet the cornea was clear. The iris was somewhat injected, but presenting in the pupil was a shriveled lens which seemed to have been luxated on the vertical meridian so that the circumferential edge projected through the pupil. The lens was chalky in appearance and showed numerous cholesteric crystals, so that it reminded one of a small, pale opal. The tension of the globe was not increased.

The patient was admitted to the Wills Hospital through the kindness of Dr. Schwenk, and was operated on early in the afternoon. The incision was begun in the usual manner, but when I was about to make the counter puncture, the lens interfered with the passage of the knife. Rather than cause a depression of the lens, I let the blade rest on the lens and

6. v. Reuss: Ztschr. f. Augenh., xxi, 269.
7. Calderaro: Clin. Oculistica, March, 1909.
8. Fuchs: Text-Book of Ophthalmology, Ed. 3, p. 447 (Duane).

made a new deflected opening rather high on the cornea. The incision was very clean. The lens stood wedged between the upper and lower pillars of the iris. An iridectomy was attempted, but owing to the lack of support of the iris, a small, unsatisfactory coloboma resulted. A narrow loop was inserted and the lens was caught in its spread, and then cautiously removed, without rupture of the hyaloid or other accident. Here I was assisted by Dr. Schwenk.

The patient was of a most vigorous type with great masses of golden hair. She stated that the only discomfort she had during the operation was a sharp pain in the teeth of the left side. On the third day the wound had healed, though there was some chemosis. In the succeeding week the patient was a little light-headed and flighty. Striped keratitis developed, and the globe was so much congested that ice was used. The patient was discharged after eleven days in the hospital.

The next day it was possible to view the fundus. The eye was entirely aphakic. There were shreds in the vitreous, and the chorioid showed rather large areas of atrophy, especially, and fortunately, in the nasal region. Three weeks after the operation with a + 8. D vision was 4/21. Three months later with a + 10 + 2.5 *axis* 135 vision was 5/9. The right eye was nearly E. and was perfectly healthy. When I last examined the patient there were but few vitreous shreds and all was satisfactory and comfortable. She had taken a long course of belladonna and mercury in minute doses. The nucleus was quite irregular in outline and showed evidences of active disintegration. It measured 4 by 5 mm. in the main diameters. The shriveled capsule was adherent to it. Much was lost by dissolution in the preserving fluid as the specimen was mislaid for several months. The particles of the capsule adherent show the presence of epithelial cells. The external surface of the nucleus is eroded and quite a broad zone is vacuolated. Some of the fibers are separated by coagulation spaces; others are swollen and present large cells, while still others are convoluted and opaque. Here and there are spherical spaces containing granules, and diagonally across the quite compact deepest layers are sharply angular slits or fissures which are highly refracting and empty. The specimens were preserved and cut for me by Dr. Nelson Brinkerhoff, pathologist of the Wills Hospital.

In the treatment of Morgagnian cataracts we must try to extract them within the capsule. Certainly, an iridectomy must be performed, and, in selected cases in which deliberation may be needful, a preliminary iridectomy will yield even better results. Lens spoons or wire loops of dimensions sufficient to engage the nucleus within their span should be used. These should be introduced well behind the lens, though held somewhat vertically, with the surgeon's mind, so to speak, occupied solely on the loop with the thought that it must be transported through an arc about the short axis of the instrument. With it the lens is pushed up against the cornea; then with a scoop pressed against the external surface the lens is made to glide well on to the loop, and it is then easily withdrawn, counter-pressure being made externally with the scoop until the lens is removed. A skilled assistant is required in this operation to manipulate the external instrument while the operator steadies the globe with the fixation forceps in one hand and the loop or spoon in the other.

It is important to observe the behavior of the escaping cortical fluid — a granular milky fluid, like fine starch grains—as it may swell through the action of the aqueous humor and if it should not all be dissipated by the time of the closure of the wound, it may excite ciliary inflammation and cause an increase of tension.

In the treatment of congenital fluid cataracts of the Morgagnian type, if there be a pouring out of the milky fluid into the anterior chamber, the aqueous should be completely evacuated at once to prevent the swelling and increase of tension, just as in senile cases.

From my own rather limited experience and a much wider observation, it would seem wise not to allow hypermaturity to extend as far as liquefaction. In the very commencement where a cataract becomes whitish or milky, we have ground to suspect that the exterior layers are fluid or semifluid. The weakness of the zonula favors rupture of the hyaloid with the consequent escape of vitreous. It is by no means easy to engage a floating nucleus, and traumatism occasioned by one's efforts to extract the nucleus may hinder the healing of the enfeebled globe. It is therefore best to encourage operation in the period of maturity and even earlier. The risks at this stage are less, all things being equal, than later. It is more than likely that the consistency of the vitreous may have become so disturbed when a cataract is overripe that the escape of it then will prove of greater moment than when even a large bead presents during the extraction of a hard cataract. Neither must the possibility of the rupture of the capsule with the dislocation of the nucleus into the anterior chamber or on to the ciliary body, as happened in the first of my cases, be overlooked. In my second case, the pressure of the hardened nucleus on this region excited such cyclitis that I am certain the chorioidoretinal inflammation had been greatly increased thereby. Sooner or later the fluid may become absorbed, or calcareous degenerative changes result; or the thickened impervious capsule may remain. Either condition would be difficult to deal with.

235 South Thirteenth Street.

ABSTRACT OF DISCUSSION

DR. E. B. HECKEL, Pittsburgh: I cannot but feel that the existence of this type of cataract is a reflection on modern ophthalmology. The question practically resolves itself into whether a uniocular, so-called senile cataract, with the other eye perfectly normal, should be operated on or not. Many advise against operation in this condition, and consequently, time has been given for a complete degeneration of the lens mass and the formation of a morgagnian cataract. A so-called senile cataract, as we well know, is not a necessary concomitant of old age or an evidence of senility, but the result of some distinct metabolic changes which, no doubt, are not limited to the changes in the lens itself but perhaps manifest themselves only in the loss of transparancy of the lens mass, and which may be accelerated if the degenerated lens mass is permitted to remain in the eye. A uniocular, so-called senile cataract should then be removed as soon as complete, even if the other eye is perfectly negative and has normal vision. The opaque lens mass should be removed not only to prevent a complete degeneration and the formation of a morgagnian cataract but also to prevent possible destructive changes to the eye itself by its presence. The opaque lens should also be removed to give the patient better vision; its removal certainly does enlarge the visual field, and although a full correction of the resulting aphakic eye may give perfectly normal vision it is usually wise not to order it as it rarely results in a harmonious singular binocular vision, so that a partial correction usually results in perfect comfort to the patient.

I do not agree with Dr. Chance as to the choice of operation for the removal of a morgagnian cataract. Operation can be done either with or without an iridectomy but should be proceeded with calmly and deliberately. The excessive use of cocain should be carefully avoided on account of its tendency to lower the tension of the eyeball and thus reduce the normal resistance or *vis a tergo* of the vitreous, and thereby render the delivery of the nucleus and the proper toilet of the eye more difficult. The use of an anterior-chamber syringe to free completely the anterior chamber of any débris is decidedly useful in this particular operation.

DR. LUCIEN HOWE, Buffalo, N. Y.: I had a case in which, by this method of Noyes, i. e., by having the patient lie on his

stomach causing the nucleus to fall forward so that it can be easily extracted, I succeeded in removing the foreign body which tended otherwise to fall back into the vitreous.

DR. C. A. CLAPP, Baltimore: What does Dr. Chance mean when he says that the metamorphosis to a liquid state is probably inflammatory in type? I can hardly imagine a tissue of the character of the lens as being inflamed with cardinal symptoms of heat, pain and redness. Is there any change in the percentage of insoluble albuminoid in these cases? I believe that this process is a true autolysis or self-digestion of the lens substance.

DR. G. C. SAVAGE, Nashville, Tenn.: The Smith capsulotomy can be properly applied in cases of morgagnian cataract or in cases supposed to be morgagnian. If the cataract is morgagnian, the milky liquid will fill the aqueous chamber the moment the capsulotomy is done. After removing the knife-needle, the head of the patient should be tilted forward so as to throw the nucleus into the aqueous chamber, where it would gravitate to the bottom. The patient now being allowed to assume a semi-erect position on the operating-chair, a small incision could be made at the lower margin of the cornea, through which at once would escape the now milky aqueous, and through which could be removed easily the nucleus of the lens by pressure or spoon. After the escape of the milky aqueous, should the nucleus not be in the anterior chamber, the head could be tilted forward sufficiently to displace it into the chamber, whence it could be removed after replacing the patient in the semireclining posture. Should the cataract prove not to be morgagnian, although appearing to be such, the extraction could be made later in the way advised by Homer Smith.

DR. BURTON CHANCE, Philadelphia: It is not at all desirable to allow cataracts to become hypermature; I offered my cases only because of the rarity of morgagnian cataracts in modern practice. I believe that it is good practice to operate on a cataract even when the fellow lens is not mature; in support of this dictum I can cite the case of a railroad engineer recently operated on with good results. I cannot give the chemical changes in the decomposed lens substance, though the débris usually excites marked reaction when left in the aqueous chamber. These cases are not ideal for a capsular extraction, although the effort should be made to remove the flaccid lenticular body at once and completely. The suggestion that the position of the patient should be changed during the progress of the operation is a valuable one, yet, in the cases here cited, the hyaloid membranes were so tender that, without doubt, rupture with serious escape would have followed had such a maneuver been attempted.

PEMPHIGUS OF THE CONJUNCTIVA

REPORT OF A CASE WITH MICROSCOPIC FINDINGS

WALTER BAER WEIDLER, M.D.
NEW YORK

Pemphigus of the conjunctiva is one of the grave diseases of the eye, and was recognized and diagnosed as such as early as 1800. Before this time it was classified with the urticarias and scabies, involving the face and eyes; many others considered it a xerosis of the conjunctiva. When this condition affects the eyes it is usually bilateral, although often unequal in the degree of severity.

There does not seem to be any constant relation between the duration of the skin affection and the development of the eye lesions. Pemphigus may affect the conjunctiva primarily, but this is rather rare, and in some of the cases so reported the lesions of the skin or mucous membranes may have been overlooked.

The course of the disease is usually very slow, extending over a period of years. Samelsohn[1] mentions a case that lasted over seven years, with little or no atrophy of the conjunctiva following, while, on the contrary, in Silcock's[2] case the one eye was completely destroyed in six weeks and the other one seriously damaged. There is no definite course or duration in pemphigus of the conjunctiva.

Crocker,[3] in speaking of pemphigus of the skin, mentions this disease as rare, occurring once in 500 cases in the skin dispensaries of England and America. It is more often seen in England and continental Europe. There are very many different forms of pemphigus, but perhaps pemphigus chronicus is most frequently seen. Typical cases of this peculiar form show oval bullæ, with tense walls and translucent contents usually bilateral, being most abundant on the face and trunk, often appearing in crops from ¼ to 1 inch in diameter with a tendency to coalesce. The duration of each bulla is a few days, but the disease may last indefinitely. In rare instances the disease may be localized in the conjunctiva. Pemphigus of the mucous membranes may appear in all of its forms, affecting the pharynx, larynx, nose and stomach.

In regard to the etiology of the disease, sex and heredity seem to be of little importance. Crocker inclines to the nervous hypothesis as an explanation for the eruption. Just what this defect is due to we are not as yet certain, but the vasomotor centers may be the root of the trouble, or, as Schwimmers concludes, it may be a trophoneurosis. The latest theory that has been advanced is that the toxins affect the nerve-endings.

REPORT OF CASE

Patient.—Mr. L. L., aged 70, Russian, said that he had never had any trouble with his eyes until six months ago, and at that time he was able to read the newspaper with glasses. He was first seen by me at the Manhattan Eye and Ear Hospital, Oct. 3. 1910.

Examination.—Right eye. Vision: Patient counted fingers at 3 feet. The iris was brown and reacted very sluggishly to light; tension was normal. The edges of the lids were covered with a dried secretion, yellowish in color, which matted the lids together. The lids were thick and shrunken. There was total symblepharon (the lids united to the eyeball, to their edges). The opening between the lids was about 8 mm. The bulbar conjunctiva was thick and thrown in folds over the cornea. A small portion of the cornea was visible. The eye presented somewhat the appearance of an old trachoma, with atrophy of the conjunctiva.

Left eye: Vision 20/200. The pupil was 3 mm. in diameter; the iris was brown and reacted to light, accommodation and convergence; tension was normal. There was the same matting of the edges of the lids. The symblepharon was very slight and deeply placed in the culdesac. At the limbus of the cornea there were several small whitish areas which, when gently rubbed with an applicator, bled freely. The conjunctiva was red and swollen, with the appearance of edema at places. The corneoscleral margin showed a number of small bleb-like formations of a pearly white color. The rest of the cornea was clear.

Oct. 20, 1910: The condition of the right eye was unchanged, except that the symblepharon had contracted more and the opening between the lids was smaller. The culdesac of the left eye seemed to be more shallow, movement of the lids less free, and it was almost impossible to evert the upper lid. There was always free bleeding of the conjunctiva on the slightest attempt to open the eyelids wide.

The shrinking grew steadily worse in the right eye until it was impossible to separate the lids. The shape of the eyeball seemed to be preserved as far as could be determined by palpation. There was a curious swelling in the upper lid, directly under the skin, which may have been an enlargement of the

1. Samelsohn: Ber. d. ophth. Gesellsch., 1878.
2. Silcock: Tr. Ophth. Soc. U. Kingdom, 1897, p. 1.
3. Crocker: Text-Book on Dermatology.

lacrimal gland. There was also edema of the upper lid, which lasted for about two weeks.

The bulbar conjunctiva presented spots of necrosis in the left eye which were white and bled very easily on the slightest attempt to make any examination of the eye. After bleeding, there was immediate ulceration and formation of synechia between the conjunctiva of the eye and the lids. The bulbar conjunctiva was slowly extending over the cornea. The small areas of necrosis with the ulceration and free bleeding, followed by the formation of synechia, and later by cicatrization and contraction, and finally, by symblepharon, which gradually became more and more complete, indicated the steady progress of the disease. The secretion of tears had been absent for about a week. The cornea showed small ulcer formations in the upper half, and the patient had noticed rapid loss of vision during the last week. Two weeks later the ulceration of the cornea was complete in the upper half, and the upper lid was tightly attached to the surface of the cornea. The vision was fingers at 6 inches. The eye was kept closed nearly all of the time and the patient complained of great pain, which was worse at night.

Frequent examinations of the urine were always negative. A von Pirquet vaccination was made, using the crude tuberculin in solutions of 10 and 50 per cent., but this gave no evidence of tuberculous foci in the body. The Wassermann reaction was also negative.

The pain and general discomfort increased with the gradual destruction of the eyes. The condition of the nose and throat was much worse and breathing became difficult. There was free bleeding from the nose whenever the patient blew his nose or tried to remove the crusts and scales. He was unable to get about by himself, and his general health and strength had been rapidly failing, and on examination of the body, three well-formed bullæ were found over the abdominal wall. The progress of the disease in the left eye was very rapid, involving twelve weeks in all to complete the destruction.

The patient was examined by Dr. Jonathan Wright, who reported as follows: "In the nose the whole of the visible walls of the cavity is covered by what looks to be a dirty, brownish, moist, shining membrane, but which is an exudate evidently closely incorporated with the subjacent mucosa. It does not bleed and cannot be stripped off. There is evidently associated with the process a degree of fibrosis, which is manifested first, by the firmness with which the exudate or surface structure is bound to the subjacent parts; second, by the bloodlessness of the surface, and third, by the fact that at the back of the vestibule where the internal nasal chambers proper and their mucous surfaces begin, the introitus is much narrowed by a fibrous contraction. With this fibrosis there is no appreciable amount of deep infiltration, no true ulceration, no necrosis of soft tissue or of bone. There is a somewhat analogous lesion of the conjunctiva. There is no other lesion or history pointing to syphilis. It is not the clinical picture of membranous rhinitis, diphtheria, syphilis, or rhinoscleroma. The eye lesion resembles the blebs one sees in acute herpes or pemphigus of the throat. It resembles such a lesion as I have once seen accompanying a similar one of an acute nature in the nose and throat, which I believed was pemphigus."

The first case of pemphigus of the conjunctiva was reported by Wichman in 1800, and the next one to be reported was that of White-Cooper,[4] London, in 1858. Later, Stellwag[5] described a condition of the conjunctiva which he called "syndesmitis degenerativa." Kries[6] and von Graefe, speaking of this same affection, called it "essential shrinking of the conjunctiva." They thought that this condition was analogous to pemphigus, and this opinion is accepted by many to-day.

Pemphigus of the conjunctiva has been classed under four separate headings:

1. Cases with blebs on the skin.
2. Those with blebs on the mucous membranes.
3. Those with blebs on the conjunctiva alone.
4. Essential shrinking only.

Von Graefe has pointed out that there is an essential shrinking or atrophy of the conjunctiva which has not been preceded by hypertrophy. Many writers assert that this shrinking is really due to the formation of vesicles and bullæ on the conjunctiva; this theory is supported by Pflüger, Sattler and Gelpe.[7] The vesicles and bullæ were seen in the late stage of the case reported in this paper. The appearance of bullæ is rather the exception in the cases that have been reported, and this may be explained by the fact that the epithelium of the conjunctiva is so soft and delicate that it cannot, like the skin, be lifted up in broad layers by the serous exudation, but ruptures and is thrown off in the form of shreds with the areas of necrosis following.

In pemphigus affecting the eye we find that the conjunctiva is usually attacked first. It is swollen and red, and one sees spots of coagulation necrosis. The discharge is free and the edges of the lids are usually glued together, and this recurs in a very short time after they have been carefully cleansed. There is some slight degree of photophobia and lacrimation, the latter being more marked in the early stage of the disease, but after the shrinking has begun the flow of tears is very much reduced and in the very late stage they are entirely absent. The inflammatory reaction extends into the subconjunctival tissues and we have the formation of new blood-vessels which bleed at the slightest effort to examine the culdesac. These inflammatory changes are not limited to the subconjunctival tissue; at times the tarsal plate may also be thickened and misshapen. The cornea is never attacked primarily and is affected only in the later stages of the disease. In some cases that have been reported there has been ulceration of the cornea, with perforation and prolapse of the lens and vitreous. At the very last stage of this disease we may find buphthalmia, staphyloma, panophthalmitis and phthisis bulbi.

In Pergens'[8] monograph on pemphigus of the conjunctiva he gives full records of 133 cases. The ages of the patients varied from infancy to 80 years. As a rule, there is no previous history that is of any assistance in making a diagnosis. The condition usually begins in one eye and involves the other later on. As regards the frequency of this disease, it is of interest to note that Steffen has seen 1 case in 84,000; Cohn, 1 in 50,000; Scholer, 1 in 50,000; Horner, 3 in 70,000; Baumler, 7 in 97,000; Pergens, 2 in 22,000; Franke, 5 in 45,000.

Since the publication of Pergens' report in 1901, I have found the records of the following additional cases:

SALVA'S[9] CASE.—Woman, aged 63. The disease began in 1900. First appeared in the eyes, later in the mouth and throat and then on the skin. The conjunctiva showed small round ulcerations which stained with fluorescin and methylene-blue. The culdesac became smaller and smaller; there were cicatricial bands, symblepharon and trichiasis. The cornea was ulcerated; pannus crassus and blindness resulted in 1902.

JOHNSON'S[10] CASE.—Woman, aged 53. The trouble followed nervous shock; eye began to give discomfort. She was first seen when there were adhesions between the lower lid and eyeball. The conjunctiva was dry and the cornea clear. The lens was cataractous. The soft palate, pharynx and epiglottis presented eruptions of pemphigus. Antisyphilitic treatment was of no avail. The eye was lost and the conjunctiva was replaced by a hard, dry, leathery tissue.

4. White-Cooper: Roy. Lond. Ophth. Hosp. Rep., 1858, i.
5. Stellwag: Lehrb. f. Augenh., 1870, p. 413.
6. Kries: Arch. f. Augenh., 1878.
7. Gelpe: Klin. Monatsbl. f. Augenh., xxiii, 191.
8. Pergens: Pemphigus des Auges, Berlin. 1901.
9. Salva: La Clinique Ophth., 1904, x. 235.
10. Johnson, R.: Jour. Eye, Ear and Throat, 1904, p. 60.

COPPEZ'S[11] CASE.—Woman, aged 23, with pemphigus of the conjunctiva, gums, cheek and uvula. Symblepharon formed and the lower two-thirds of the cornea became opaque.

KOERBER'S[12] CASE.—Pemphigus of the palate and glans penis. The lower culdesac was narrowed and attached to the eye by bands. Both corneas were clear. Culture showed diplococcus.

BROWN'S[13] CASE.—Woman, aged 48. Blebs were seen on the cornea. Patient died one year and a half after the first eye symptoms were noted.

ANDERSON'S[14] CASE.—Woman, aged 29. There had been acute pemphigus foliaceus since August, 1903. Conjunctiva and facial manifestations were seen in November. The skin and mucous membranes showed remains of the vesicles. They were seen in the culdesac, but no mention is made of any symblepharon formation.

NETTLESHIP'S[15] CASE.—Boy, aged 8, with symblepharon and scarring of four eyelids, six months in duration; no recurrence in four years.

OGILVY'S[16] CASE.—The patient was a farmer. The first attack lasted six weeks. The eyes were then quiet for six weeks. A second attack followed at this time; the cornea became opaque and the conjunctiva became shrunken with ectropion. Lanolin was used locally.

BANE'S[17] CASE.—The patient was under observation for two years. There was ectropion of the lower lid and cicatricial contraction of the conjunctiva, and in the middle third a symblepharon was forming. A conjunctival flap failed to check the progress of the disease. A portion of conjunctiva removed from the lower culdesac was examined by Todd, who reported that the specimen consisted of cicatricial granulation tissue.

SHERMAN'S[18] CASE.—Man, aged 68. Patient had had eye trouble for ten weeks. There was some slight discharge; the conjunctiva was slightly thickened in the lower lid. There were several areas of denudations and the culdesac was shallow. The condition progressed. Treatment: weak solutions of silver nitrate to lids and arsenic internally.

ADAMS'[19] CASE.—Woman, aged 57. There was a free eruption and ulceration of the pharynx besides the conjunctival manifestation. Treatment consisted in the use of arsenic, atoxyl and fibrolysin. Transplantation in the culdesac was tried. The case ended fatally through rupture of pharyngeal eruptions.

QUINT'S[20] CASE.—Patient, aged 16, had typical eruptions of pemphigus on the conjunctiva. There was a complete symblepharon in the left eye and partial in the right. The mucous membrane of the nose and throat presented similar eruptions.

SHUMWAY'S[21] CASE.—Man, aged 40 (?). Besides the conjunctival eruption there was a general involvement of the skin and mucous membranes; broad symblepharon involving the inner third of the lower lid and a gradual extension of opaque tissue over the cornea. Bullæ were noted during the progress of the disease. No operation was attempted. The patient was under treatment for seven months.

WOLLNER'S[22] CASE.—The eruption was localized to the conjunctiva. The patient was under observation for three years.

LANDOLT'S[23] CASE.—Man, aged 41. Previous history of trachoma (?). Left eye was completely involved and the right partially. Three years after onset there was total symblepharon in the right eye with xerosis, and only slight perception of light. Transplantation of skin from face and lids, with good results, lasting four years. Left eye was enucleated later because of discomfort.

PATHOLOGY

The pathology of this disease is still obscure. Sattler[24] reports the microscopic findings in one case. He observed that the swelling of the conjunctiva bulbi was not due to the infiltration of the conjunctiva with lymphoid cells, but partly to a great swelling of the connective tissue bundles, and partly to the expansion of the fissure spaces which were filled with liquid. The subepithelial layer of the conjunctiva bulbi formed a special modified membrane about 40 microns broad, more turbid than the rest of the tissue, being almost opaque and running parallel with the surface of the conjunctiva and covering the greater part of the cornea. This subepithelial turbid layer might easily be mistaken at first sight for the epithelium itself. The entire stroma of this layer was pervaded by granular bodies, which did not stain with Bismarck brown or hematoxylin. The blood-vessels of the conjunctiva were numerous and much congested. They were not, however, apparent on superficial view of the conjunctiva, being concealed by the condition of the epithelium. This epithelium had lost totally its normal character. From the deepest layers to the most superficial it consisted of horny cells. It was 30 microns thick and separated easily from the underlying conjunctiva.

Baumler[25] reports a case and gives about the same findings except that he mentions a hypertrophy and a papillary formation of the epithelium.

Collins[26] has made a contribution to our knowledge of this disease by reporting the macroscopic and microscopic findings of two cases of pemphigus of the conjunctiva. In the first case he found from the macroscopic study that the cornea showed a great convexity and that on the anterior surface of the cornea there was a layer of tissue quite different from the normal epithelium. The iris was atrophied and attached to the posterior surface of the cornea. The lens was shrunken and adherent to the cornea. The vitreous fluid and retina were *in situ*. There was cupping of the optic nerve head. Microscopically viewed, he found the epithelial layer of the cornea thickened and a number of finger-like processes dipping down into the fibrous layer of the cornea, several areas of round-cell infiltration, and a number of new blood-vessels. Descemet's membrane was absent in places. In the second case the findings were very much the same.

Microscopic examination of a small portion of the conjunctiva excised from the lower culdesac of the right eye of my case revealed the following: The specimen was hardened in formaldehyd solution and the gradual increasing alcohols, and stained in hematoxylin and eosin. The outer portion of the specimen was made up of round cells in great abundance and blood-vessels, making a partial capsule around the central fibrinous material. In the outer edge of the specimen were seen necrotic changes in the cellular proliferation. This outer limiting edge showed some flat cells and some tendency to hornification. There was great invasion of leukocytes throughout, more or less centralized in spots. At places eosinophils were seen. There was a most remarkable increase of blood-vessels; these should more properly be called blood-paths, as they did not have well-formed vessel walls. Some of the larger ones had a well-formed wall of cells without the formation of the different coats. These blood-paths were well filled with red blood-corpuscles. The leukocytes, which made up the greater portion of the section, presented all the different stages of cell division. In the center of the section there was a mass which took the eosin stain only and consisted of red corpuscles and fibrin. This was the hemorrhagic portion of the specimen and was the result of the dissection of the tissue from the culdesac. A few leukocytes could also be seen in this hemorrhagic area. There was no attempt to form any connective tissue or any new form of specialized tissue growth. The polymorphonuclear leukocytes predominated.

11. Coppez: Bull. de la Soc. Belg. d'Ophth., 1905.
12. Koerber: Centralbl. f. Augenh., 1905.
13. Brown: Ann. Ophth., 1904, xiii, 535.
14. Anderson: Tr. Ophth. Soc., 1904, p. 19.
15. Nettleship: Tr. Ophth. Soc., 1904, p. 22.
16. Ogilvy: Arch. f. Ophth., 1905, p. 277.
17. Bane: Ann. Ophth., 1908, p. 405.
18. Sherman: Arch. f. Ophth., 1909, p. 140.
19. Adams: Berl. Ophth. Gesellsch., 1909.
20. Quint: Klin. Monatsbl. f. Augenh., 1909.
21. Shumway: Ann. Ophth., 1910.
22. Wollner: Klin. Monatsbl. f. Augenh., 1911.
23. Landolt: Arch. d'Ophth., 1910, xxx, 337.
24. Sattler: Quoted by Morris and Robert in Brit. Jour. Dermat., 1888, p. 180.
25. Baumler, Zeh: Klin. Monatsbl. f. Augenh., 1885, xxiii, 337.
26. Collins: Tr. Ophth. Soc. U. Kingdom, 1890, p. 62.

BACTERIOLOGY

Considerable work has been done along bacteriologic lines of study of pemphigus of the conjunctiva. Elaborate studies have been made of the secretions and discharges found in eyes so affected, but no real importance can be attached to the results.

Gelpe found in a case reported in 1885, the presence of micrococci, diplococci, and on making a culture of another case, he was able to show streptococci. Sachsalber[27] later found the presence of the diplococcus, the streptococcus, tetragenus, and comma vibrans. Bellecontre[28] demonstrated streptococci and staphylococci, and Franke,[29] from a culture, found the pseudodiphtheritic bacillus and the staphylococcus.

Lipschutz,[30] from his microscopic studies, advances two theories in regard to the etiology of this disease, the neuropathic and the bacterial or parasitic. By some investigators the contents of the blisters or vesicles have been found sterile, but others have found that they contain strepto- and staphylococci. Lipschutz further claimed to have found something characteristic in the plasma which he called cytoplasma.

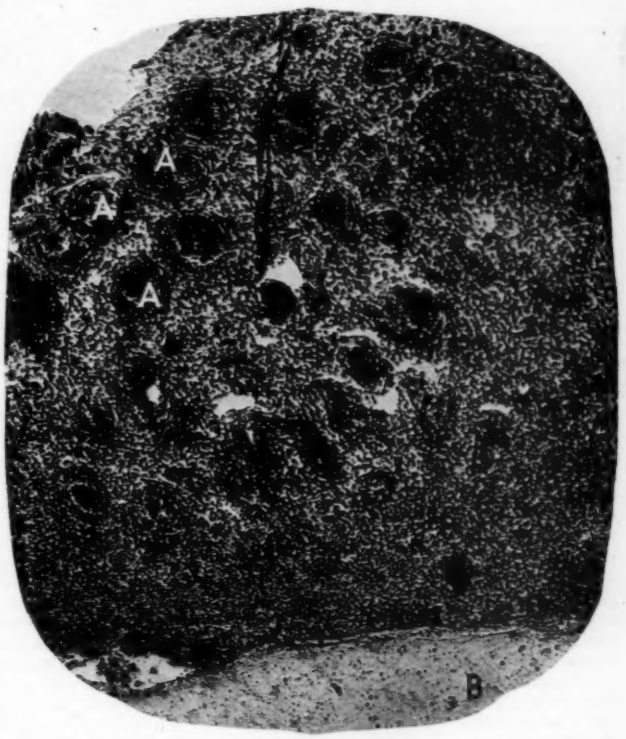
Bacteriologic study of the case reported in this paper showed the following: a smear made of the secretion from the right eye showed the presence of pus-producing organisms only; in a culture using agar as the medium for growth, the presence of streptococci and pseudo Klebs-Loeffler bacilli was demonstrated.

TREATMENT

As regards the treatment of pemphigus of the conjunctiva, there is not much that can be offered that is new or of any great value. Arsenic, in all of its forms, has been used most generally, and when used, it should be pushed to its physiologic limit. It is of interest to know the different forms of treatment used in such a disease from time to time. Cooper, in the treatment of his case in 1858, used cold compresses, opened the bullæ and applied silver nitrate. Hassen[31] tried zinc sulphate in varying strengths, and Sattler and Pflugler used milk and oils. Barthelen and Sachsalber recommended lanolin and glycerin. Bellecontre, after his microscopic studies, made experimental use of antidiphtheritic serum injection. There were no especial improvements noted, but he asserts that it helped to check the progress of the disease.

Transplantation of conjunctival tissue, mucous membranes and skin have been tried at different times, but the results have not been eminently successful. The difficulty seems to be in getting the grafts of tissue to grow, notwithstanding the great vascularity of the conjunctiva. Not being satisfied with the results of Sattler's experiments in the surgery of this condition, von Graefe tried the transplantation of mucous membrane from a dog and also from the mouth of a man with no better results. Sachs,[32] in his cases, used the skin from the prepuce, but did not have great success as a reward for his efforts. None of these men had what might be called even fair results, as none of them succeeded in stopping the progress of the atrophy and symblepharon formation. Marple reports a case in which he used the skin from the inner side of the arm near the axilla. The graft took well and he was able to stop the progress of the disease. Four years after the operation the condition had not advanced and the disease was quiescent. Operative measures have also been employed in the hope of checking the deformity of the lids, and these also have been most unsatisfactory.

The treatment employed in my own case was a boric acid wash four times a day to keep the lids clean, and gentle applications of silver nitrate and the copper stick. Olei ricini was used three times a day to relieve the dryness of the conjunctiva and at other times this was alternated with liquid petrolatum. Arsenious acid was given over a long period of time, in gradually increasing doses. It did not seem to improve the patient's general health or have any especial action in the eye condition. The patient was urged to come into the hospital, but this was refused on account of his religious scruples. Operative measures were suggested for relief of the disease and the rapidly increasing destruction, but this was also refused.



A section of conjunctiva from the lower culdesac, showing round-cell and leukocytic infiltration, new "blood-paths" or channels (A) and hemorrhagic area (B) below. × 90.

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27. Sachsalber: Klin. Monatsbl. f. Augenh., 1894, p. 241.
28. Bellecontre: Quoted by Pergens, Pemphigus des Auges, Berlin, 1901.
29. Franke: Der Pemphigus und die essentielle Schrumpfung der Bindehaut des Auges, Wiesbaden, 1900.
30. Lipschutz: Centralbl. f. Bakteriol., May, 1910.
31. Hassen: Quoted by Pergens, Pemphigus des Auges, Berlin, 1901
32. Sachs: Wien. klin. Wchnschr., 1899, p. 671.

ABSTRACT OF DISCUSSION

DR. CASEY WOOD, Chicago: During an experience of twenty-five years, I have seen three cases of ocular pemphigus. In two of these the eruption attacked the cornea of both eyes;

in one case the patient became so blind that vision was reduced to perception of shadows. In neither of these cases did any therapeutic measure do more than relieve some of the symptoms.

In a more recent instance the disease was confined to lower culdesacs, but involved both the ocular and palpebral conjunctivæ, resembling Koerber's case briefly outlined by Dr. Weidler.

Looking back on my slight experience of ocular pemphigus, I have noticed that the disease is frequently mistaken for and treated as a manifestation of trachoma and this is an error that in some instances may easily be made.

DR. H. W. WOODRUFF, Joliet, Ill.: I operated for complete atrophy of the conjunctiva in a case which I attributed to pemphigus. There might be some doubt as to the diagnosis, but it had reached the stage of complete atrophy so that there was no longer any culdesac. It may be that trachoma may reach that stage after a long time, but I had never seen such a case and attributed it to pemphigus. I entirely relieved the contraction by skin-grafting after the method of using a plate of block tin with the skin graft placed over the tin, doing it in two operations; that is, restoring the lower culdesac first and afterward the upper one. This gave the patient some mobility of the eye, but the clearness of the cornea was not restored.

DR. E. L. JONES, Cumberland, Md.: I saw a very severe and typical case four or five years ago in which Dr. Price, of Frostburg, had made the diagnosis. It was in an elderly woman already affected for several years with pemphigus in the vagina. It had now affected the eye which looked as though it had been scalded, with white blisters. It gradually extended until the entire conjunctiva was destroyed, also the cornea, and everything was matted and massed together. In the course of time the other eye was affected similarly. The disease lasted ten years or more. The mouth was invaded by white blebs of gelatinous consistency, followed by atrophy and stricture of the esophagus with intense suffering, and for years the patient could only swallow milk in small sips. All sorts of treatment were tried but nothing availed. The woman has recently died.

DR. JOSEPH S. LICHTENBERG, Kansas City, Mo.: I had a case exactly parallel with Dr. Weidler's. The history was indefinite; it could not be determined whether it was trachoma or pemphigus but from the age of the patient and the history it was concluded that it was pemphigus. In this case I restored all four culdesacs with mucous membrane grafts taken from the mucous and submucous tissue of the lips on the Wolff principle and not on the Thiersch principle. This case is now of four or five years' duration and still holds good.

DR. WALTER E. LAMBERT, New York: I was called by a general practitioner to see a patient on account of the very serious involvement of both eyes in a case diagnosed as acute septic pemphigus, resulting from a streptococcus infection after a submucous operation in the nose. The patient had a most extensive eruption, vesicular and pustular, involving the mucous membrane of the mouth, throat and eyes, and the skin over the entire body. There was quite a high temperature and the suffering was intense. The attending physician was greatly perplexed, and at first, thinking it was a case of small-pox, had called in a health officer. Dr. George T. Elliot saw the case in consultation, and made a diagnosis of acute septic pemphigus. The patient died from general septic infection three or four days later.

DR. WALTER BAER WEIDLER, New York: When this patient was received in the clinic the diagnosis made was trachoma, but Dr. Thomson seeing the patient immediately suggested the diagnosis of pemphigus, and thorough study of the case proved the correctness of that diagnosis. The patient was presented at the Academy of Medicine and at the ophthalmologic and the dermatologic sections and there were some who doubted the correctness of the diagnosis, because there had been no general eruption whatsoever, but there were lesions which we were able to demonstrate in the nose. Both eyes were completely sealed together at the palpebral margins, and on the patient's last visit to the clinic there was a general eruption of pemphigus seen on the abdominal walls.

ORBITAL CELLULITIS FROM DISEASE OF THE SUPERIOR MAXILLA IN CHILDREN

WILLIAM CAMPBELL POSEY, M.D.
PHILADELPHIA

Orbital cellulitis in children is not very uncommon, and I should hesitate to ask the Section to devote any time to its consideration were it not for the fact that I believe the sublying cause in many of the cases which come under our observation is permitted to remain undetermined, and that we proceed with surgical and therapeutic measures without trying to analyze thoroughly the agency in each particular case which may have given rise to the cellulitis. It shall be my endeavor, therefore, to elucidate, as far as I am able, the various conditions which may operate as etiologic factors in this affection, and to illustrate one phase of the subject I shall, without further preamble, recite the histories of two cases which I have had under my care at the Children's Hospital during the past few years.

CASE 1.—*History.*—F. C., female, aged 1 year, came to the hospital Dec. 15, 1906, on account of a deformity of the left lower eyelid and a discharging fistula in the same location. The history as recorded by the resident physician, Dr. Vail, is as follows: The patient was the first child; no difficulty at birth; breast-fed; vaccinated when 3 months old by the family physician; parents living and well. When the child was 8 months old the left axilla swelled and was opened, pus escaping. Pertussis occurred one month later, followed by pneumonia; with convalescence after two months. A month later the left eye swelled and the lids shut tight, much pus running from the eye. About the same time an abscess in the cheek opened spontaneously by way of the mouth.

Examination.—At admission, the head was found well formed, the left lower lid ectropionized, with a discharging sinus at the lower outer angle of the orbit. Examination of the nose and throat was negative; vaginal smear negative.

Treatment and Course of Disease.—Under ether I passed a probe into the orbital sinus and dead bone was encountered on the floor of the orbit. This was removed by curet and dissection, an incision having first been made along the lower rim of the orbit. Part of a newly-formed but decayed tooth was removed from the upper left alveolar process. Although the left cheek was considerably swollen, no sinus could be detected in the mouth. The orbital wound was drained by a small tube. The wound was dressed daily, copious quantities of pus escaping through the drainage tube at each dressing. At the expiration of six days after the operation the wound failed to drain and orbital cellulitis supervened, the eye being proptosed and the bulbar conjunctiva ecchymotic. Dr. Packard saw case in consultation and concurred in the diagnosis of necrosis of the left superior maxillary bone. The patient was etherized a second time, the orbital wound thoroughly drained and a sinus discovered leading from the dead bone in the floor of the orbit into the cavity of the bone. The bone was incised through the cheek just above the alveolar process, and a drainage-tube passed from the orbit through the bone into the mouth, thereby establishing free drainage. Subsequent recovery was uneventful, the swelling in the orbit and over the superior maxillary gradually subsiding, and after some weeks the sinuses drying up. Tonics and mercurial inunctions were administered throughout the entire course of the disease.

CASE 2.—*History.*—M. Z., aged 2 years, was admitted to the wards Nov. 2, 1911, on account of a marked prominence of the left eye, with swelling of the lids and adjacent cheek, which had been present for some days before admission. The mother stated that the child had been in good health, following an operation for abscess on the chest (empyema) some four months previously, and denied the possibility of the condition being due to a traumatism.

Examination.—Marked proptosis of the left eye was evident with all the attendant signs of orbital cellulitis. The left cheek was also puffed and the palate and alveolar border were found to be indurated and swollen. The left pupil was slightly dilated and an ophthalmoscopic examination revealed some pallor of the optic nerve, with distinct engorgement of the retinal veins. The right eye and side of the face were unaffected. Dr. Packard examined the nose and throat and pronounced them to be normal.

Treatment and Course of Disease.—The case being regarded as one of osteomyelitis of the superior maxillary bone, the patient was etherized and the orbital tissues and the alveolar border were freely incised, giving exit to a large quantity of thick pus. A number of loose teeth were also removed from the affected alveolus. No dead bone was encountered. The orbital wound was drained from its most dependent portion and a dressing applied. At the end of three weeks all the sinuses had closed and the child was discharged from the house. Two weeks later, however, she was readmitted, on account of a painful swelling of the left leg. This was incised and found to be dependent on disease of the tibia. At the end of another week the swelling reappeared in the left upper jaw and there was some proptosis. The patient was again etherized and with the aid and counsel of Dr. Packard the orbital and alveolar tissues were again incised. Several more dead teeth with sequestra were removed from the upper jaw and free drainage established from the orbital and alveolar structures. The floor of the orbit seemed smooth anteriorly, but rough posteriorly, though it was impossible to assert positively that the bone was actually necrosed. Healing slowly followed, the sinuses gradually closing, and the child was discharged at the end of another month as cured.

In neither case was there a history of traumatism, and in neither had the attention of the mother been called to any nasal condition, and a careful examination of the nose by Dr. F. R. Packard, the rhinologist to the hospital, which was made while the inflammation was at its highest, failed to reveal any evidence of nasal or sinus disease. A history of inherited syphilis could not be obtained in either of the two cases and signs of tuberculosis were absent. In each of the cases, however, there was evidence of previous infection of the general system, i. e., axillary abscess and pertussis, followed by pneumonia, in the first case, and empyema in the second, while in the second, staphylococci were found in the discharges. Unfortunately, no culture was made in the first case.

I am led, therefore, to the supposition that the orbital cellulitis in these cases was due to disease of the superior maxillary bone, to an osteomyelitis, doubtless secondary to a general blood infection.

ANATOMIC CONSIDERATIONS

When one considers the structure of the superior maxillary in infancy and early childhood, the reason for its not infrequent involvement in infectious processes is not difficult to understand, for at that age the bone is quite a different structure from what it gradually evolves into later. For example, to quote Logan Turner:[1]

"At birth the body of the superior maxillary is made up almost entirely of the alveolar process of the jaw, the sockets of the teeth being almost in contact with the orbital plate of the maxilla forming the floor of the orbital cavity. The antrum exists merely as a slit-like indentation on the outer wall of the nasal chamber, and there is, therefore, at birth no maxillary sinus beneath the orbit." According to Turner, "the growth of the body of the bone, and with it an increase in the size of the face, takes place by the formation of a mass of cancellous or spongy bone between the alveolar process and the orbital plate of the maxilla. In this way the alveolar process, along with the teeth, becomes separated from the orbital plate. A little later, coincidentally with the increase in the cancellous tissue on the facial and dentary aspects of the bone, a process of absorption apparently takes place on its nasal and orbital surfaces, thus causing an increase in the size of the antrum. This simultaneous process of growth and absorption continues until the eruption of the third permanent molar or wisdom tooth at or about the twenty-fifth year of life, at which time the antrum reaches its complete or adult form."

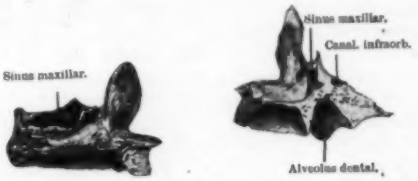

Fig. 1.—The left superior maxilla of a new-born child, viewed on its nasal aspect. This and the three following figures show the development of the superior maxillary bone from "The Accessory Sinuses of the Nose," by A. Logan Turner.

Fig. 2.—Vertical transverse section through the right superior maxilla of a new-born child, viewed from behind. The antrum is a mere recess on the nasal aspect of the bone, and the teeth sockets lie almost in contact with the floor of the orbit.

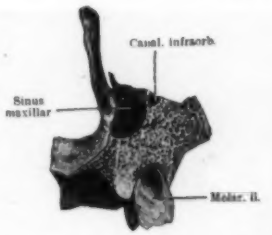

Fig. 3.—Vertical transverse section through the right superior maxilla during the first dentition, on the plane of the second molar tooth. The antrum, viewed from behind, is small, and the body of the maxilla consists mainly of cancellous bone.

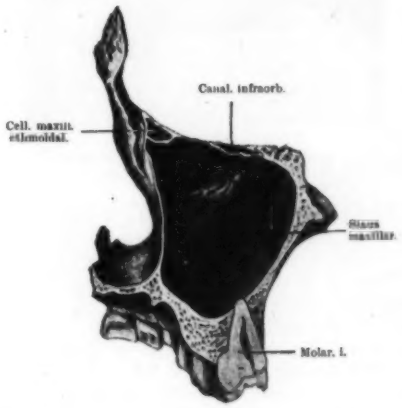

Fig. 4.—Vertical transverse section through the right superior maxilla of an adult, viewed from behind, on the plane of the first molar tooth. The section shows that the cancellous bone is almost entirely absorbed and that the maxillary sinus has reached its full dimensions. The fang of the tooth projects into the floor of the sinus.

In infancy, therefore, the cancellous structure of the bone largely predominates, rendering it especially liable to inflammatory processes.

1. Turner, Logan: Accessory Sinuses of the Nose, Edinburgh, 1901, p. 5.

Four illustrations (Figs. 1, 2, 3 and 4) have been reproduced from Turner's admirable book, which will illustrate the changes which have just been described, and demonstrate the manner in which the bone evolves from a mass of cancellous bone to a thin framework, offering attachment to the upper teeth, forming walls for the important spaces which surround it, as well as for the huge antral cavity within its structure.

When the complexity of the mechanism of dentition is considered, it becomes apparent, I think, how easily infection of the alveolar border may be followed by a general inflammatory process of the entire bone. A study of the literature has revealed a number of cases in which such was the case, the inflammation being apparently conveyed to the alveoli by an infected nipple during the act of suckling. The alveolar border once involved, suppurative periostitis soon extends rapidly under the periosteum along the anterior surface of the upper jaw or through the maxillary antrum to the orbit. As a rule, an acute osteomyelitis of the entire superior maxillary follows with all the signs of an active inflammatory process, such as is observed from whatsoever cause. The cheek and lids become swollen, the globe is proptosed and its movements restricted. The hard palate is swollen and edematous and the alveolar process tumefied. There is a marked tenderness over the superior maxillary and pain may be complained of. This may be localized or may radiate into the temple, forehead, into the nose and teeth, or may be referred to the entire half of the corresponding side of the face. The pain may be most intense, especially at night, and may be accompanied by vomiting. The inflammation in the orbit may extend along the periosteum posteriorly, and, invading the sphenoidal fissure, may implicate all the nerves of the orbit, both motor and sensory. The Gasserian ganglion may become affected and keratitis neuroparalytica may supervene with or without concomitant symptoms. Phlegmon of the orbit may arise from inflammation of the fatty cellular tissue of the orbit and may be followed by thrombosis of the orbital veins or even of the cavernous sinus.

Not infrequently the optic nerve becomes implicated and the ophthalmoscope may reveal the signs of neuritis, and if the inflammation be continued, of atrophy. After a variable period of time, but generally rather rapidly, cure may follow by absorption and the affection may disappear without leaving a trace; more usually, however, spontaneous evacuation follows the suppurative process and fistulas persist in the orbit and in the mouth. In consequence of the former, cicatrices affect the lid and ectropion results. At times the entire lower rim of the orbit may slough away, leaving a most disfiguring, indrawn scar (Figs. 6 and 7). As is usually the rule in osteomyelitis, the sequestrum shows but little tendency to separate itself from the living bone for a long time, so that healing is frequently very protracted.

Orbital cellulitis may arise from disease of the superior maxillary in consequence of traumatism; indeed it not infrequently happens that a very slight blow will excite most active symptoms in children in whom the vitality has been lowered by some form of exhausting disease.

Morax[5] has recently drawn attention to this class of cases and describes how staphylococci circulating in the blood may infect the site of a contusion endogenously and may give rise to osteomyelitis in cases in which there had been no wound in the integument. Willard[6] asserts that while the staphylococcus is the most common bacterium present, the pneumococcus and streptococcus, or other organisms are occasionally encountered.

Fig. 6.—Case 2, showing sequel of orbital cellulitis; fistula at lower outer rim of orbit, with swelling of the cheek.

Fig. 7.—Tuberculosis of the superior maxillary bone with abscess of the orbit, showing ectropion of upper lid due to cicatricial connections with upper rim of orbit.

While no history of trauma was obtainable in either of my cases, it is not unlikely that some slight injury may have occasioned and excited the inflammation in the superior maxillary, the bacteria in the blood acting endogenously in giving rise to the general osteomyelitis.

Contusion of the orbit is especially liable to be followed by caries of its walls when the subjects are tuberculous, such as is observed when other bones are injured in this class of cases. Tuberculosis may affect the orbit, however, without the necessity of an injury to excite it, the superior maxillary and the malar being in common with the inferior maxillary the most common seat of tuberculosis of the face.

5. Morax: Ann. d'oculist., March, 1905, p. 208.
6. Willard: Surgery of Childhood, 1910.

We are now brought to a consideration of the possibility of orbital cellulitis in the class of cases under discussion being occasioned primarily by an inflammation of the maxillary sinus, and while there are those[8] who assert that the antrum is too small at such an age to be the seat of an inflammatory process sufficient to excite an osteomyelitis in the body of the bone, it seems to me that the recent studies of Onodi and the large number of clinical observations which have been recorded by trustworthy observers attest that such may be the case, and that we must acknowledge that such an inflammation may not be an infrequent cause of disease of the orbit in children.

All of us will doubtless bear testimony to the debt ophthalmology owes to Onodi in his elucidation of the manner in which the optic nerve may be involved from sphenoiditis and ethmoiditis in adults, and it is my opinion that the observations of this distinguished Hungarian rhinologist in his most recent volume[9] will prove of equal value to us. I have ventured to reproduce a number of the plates from this book, which show the development of the antrum and trace the growth of the cavity through its entire development.

The reproductions have been reduced in size, but show in coronal, horizontal and longitudinal sections the topographic relations and form of the maxillary antrum from birth to the eighth year.

These investigations prove apparently that the antrum is quite large enough to become the seat of inflammation even in the earliest months of life. To these favoring anatomic conditions the weight of actual clinical experience may now be added.

In an admirable dissertation, Guisez[10] has given the clinical picture of maxillary sinusitis in the infant and attributes the common or acute form to grippal coryza, to involvement of the mucous membrane of the sinus during convalescence from infectious diseases, or, in fine, to any form of nasal infection. On account of the thinness of the anterior wall of the sinus at that age, he asserts that the sinusitis manifests itself principally by the external symptoms, which are, in consequence, much more accentuated in infants than in adults. The cheek swells and is edematous, the lids become involved and the tissues of the orbit are affected. Discharge from the nose is at all times incessant and abundant. Osteomyelitis of the body of the bone follows and caries sets in. In one case of an exceptionally severe nature, which nearly terminated fatally, Guisez was compelled to operate to relieve the symptoms occasioned by thrombosis of the ophthalmic vein.

Comparatively recently Beauvois[11] sums up the entire subject in a masterful manner and in addition to other cases cites that of an infant 15 days old, in which orbital inflammation was attended by a copius discharge of pus from the nose, the exophthalmos gradually disappearing as the nasal discharge subsided. Beauvois suggests that in very young infants the leukorrheal discharge of the mother may readily infect the nose of the infant, or the contagion may be conveyed through the medium of the bath or even of the air.

Fano,[12] Weissman and Fiocre[13] and Dujardin[14] have all reported cases of sinusitis in children, the latter in an infant 19 days old.

It has long been a matter of clinical experience that orbital cellulitis may follow scarlet fever, measles, typhoid fever, tonsillitis, erysipelas, small-pox and other infectious diseases, and there is strong evidence that in many of these cases, at least, the inflammation in the superior maxilla follows a primary involvement of the antrum.

Lange,[15] for example, in a paper containing most of the literature on the subject, has reported six cases following scarlet fever, in which an acute empyema of the sinus gave rise to osteomyelitis of the superior maxilla and terminated in caries of the bone with the formation of sequestra, precisely as is so frequently observed in middle-ear disease after this form of fever.

Estor[16] is authority for the statement that maxillary sinusitis may also originate in children from a carious tooth, just as it does in adults, the alveolar process becoming infected and the inflammation spreading by continuity of tissue under the periosteum to the antral cavity.

While American literature, which is so full of original treatises on all forms of sinus disease and its treatment, contains but scant reference to the subject, F. Krauss has recently reported a case of orbital involvement from disease of the superior maxilla in a 4-months-old child, in which the inflammation was apparently dependent primarily on antral disease.

As in the diagnosis of disease of the sinuses in adults, much information may be derived from an *x*-ray study of their condition in children, and those interested will do well to consult the splendid series of radiograms of infants' sinuses recently published by Haike,[17] as well as those by Onodi. In all suspected cases of primary sinusitis, care should be exercised to exclude the presence of a foreign body in the nose and intranasal syphilis.

Syphilis, however, of the superior maxilla is rare in children. Neither Hutchinson nor Keyes refer in either of their text-books to the possibility of this bone being the seat of syphilis in young subjects, though both describe at some length the infiltration and softening between the tables of the skull and in the sutures, and the diffuse periostitis of the frontal and parietal bones, which occur at this age. Indeed, Hutchinson[18] asserts that while children of the age of 6 to 10 to 14 years appear to be prone to suffer from bone disease of a syphilitic nature, and at this period of life multiple periostitis of a very extensive kind is not uncommon, the periostitis of inherited syphilis which leads to suppuration is but seldom met with in infancy. When syphilitic periostitis does affect the orbit, both cavities are usually involved and the diagnosis is rendered easy by the evidence of periostitis elsewhere in the body.

Treatment consists in early evacuation of the pus from the orbit and of establishing proper drainage from that cavity and through the body of the superior maxilla if it, too, be the seat of disease.

Prompt healing may follow, and even when necrosis of the bone occurs, almost complete regeneration of the bone will take place provided the periosteum be saved.

8. Axenfeld (Bacteriology of the Eye, p. 387), with his vast experience, says that these rare cases of orbital cellulitis in infants cannot be associated with affections of the sinuses, as these latter are either absent or underdeveloped up to the eighth year, and asserts that it is only after the sixth year that a nasal etiology becomes important. The youngest subject he has seen with orbital abscess which certainly originated from a sinus (sphenoidal containing streptococci) was 9 years old.
9. Onodi: The Accessory Sinuses of the Nose in Children.
10. Guisez: Le Pratique des maladies des enfants, p. 346.
11. Beauvois: Rec. d'ophth., 1908, p. 54.
12. Fano: Jour. d'ocul. et chir., Paris, 1873-1874, i.
13. Weissman and Fiocre: Ann. d. mal. de l'oreille et du larynx, 1906.
14. Dujardin: Jour. d. Sc. méd. de Lille, Feb. 24, 1888.
15. Lange: Med. klin., Aug. 19, 1906.
16. Estor: Guide pratique de chirurgie infantile.
17. Haike: Arch. f. Laryngol. u. Rhinol., 1910, xxiii, 217.
18. Hutchinson: Text-Book on Syphilis, p. 389.

Should deformities of the lids occur in consequence of contractions from fistulæ, they should be corrected by plastic operations some months after all acute symptoms have subsided.

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ABSTRACT OF DISCUSSION

DR. F. R. PACKARD, Philadelphia: Dr. Posey calls his case a case of orbital cellulitis due to disease of the superior maxillary bone—not due to disease of the maxillary sinus. I remember in the 1910 meeting of the American Otological Society, Dr. William C. Braislin, of Brooklyn, read a paper on the accessory sinuses of the nose in a 5-year-old child, with notes on cases of suppuration of the antrum of Highmore at and before that age. He described one or more cases practically identical with the two reported by Dr. Posey. In the discussion that followed, a great majority took the view that there was no such thing as suppuration of the antrum in a child 1 or 2 years of age; in other words, that the antrum was not sufficiently developed to permit of suppurative disease, in the true sense of that term. As Dr. Posey said, Onodi has pointed out recently, in agreement with other men who work on the accessory sinuses, that this sinus is appreciably well developed in the first year. Onodi has done more than anyone else to show that this sinus is the first one to be developed. It is present at birth and within a month is a fair-sized cavity. At that time also its opening is large and its floor is lower than the ostium. In other words, at a very early age the maxillary antrum possesses the same disagreeable characteristics as in adult life, namely, a large portal of entry for organisms and poor facilities for drainage. The cases, however, which are reported ordinarily as maxillary suppuration in young children have all of them, as far as I can learn, presented characteristic disease of the maxillary bone, and not the ordinary suppurative sinusitis.

I believe that the explanation of these cases is to be found, not only in the entrance of infection between the teeth, as Dr. Posey mentioned, but also in the fact that the child's nose is just as susceptible to inflammation or infection as the adult's and that the large size of the antral opening, which is very much larger in early childhood than in the adult, accounts for some of these infections, and therefore if micro-organisms once get in either through the tooth-channel or the ostium, the large mass of cancellous bone tissue which undergoes subsequent absorption to form the antral cavity is the kind of bone which is susceptible to osteomyelitis and other inflammatory bone troubles. In other words, I think Dr. Posey chose wisely when he termed his cases diseases of the maxillary bone and not of the sinus, although the infection of the bone occurred through the small chamber corresponding to the large antrum which we find in the adult skull.

MEASUREMENT OF FATIGUE OF THE OCULAR MUSCLES

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I. INTRODUCTION

1. *Object.*—The object of this study was to obtain a record written by the ocular muscles themselves of the fatigue which they develop under various circumstances. This was with the expectation—which has apparently been realized—that the data thus furnished would enable us to separate more clearly the factors which, when grouped together, have been called "eye-strain."

2. *Method.*—The autographic records here referred to have been made by a modification of the ergograph. This is a piece of apparatus well known to physiologists, and described now in all of the text-books on that subject. But as it is important for our purpose to understand the principle on which it depends, its construction and action, it is desirable first to consider briefly the measurement of fatigue in other muscles, in animals and in man.

II. FATIGUE OF MUSCLES OF THE HAND OR LEG AS MEASURED BY THE ERGOGRAPH

More than twenty years ago an Italian, Mosso, measured the fatigue produced when a given group of muscles contracts repeatedly. To the last phalanx of one of the fingers he attached a sort of glove, from which a string extended horizontally over a pulley, and to the other end of which a weight was attached (Fig. 1). Each contraction of the finger required a given amount

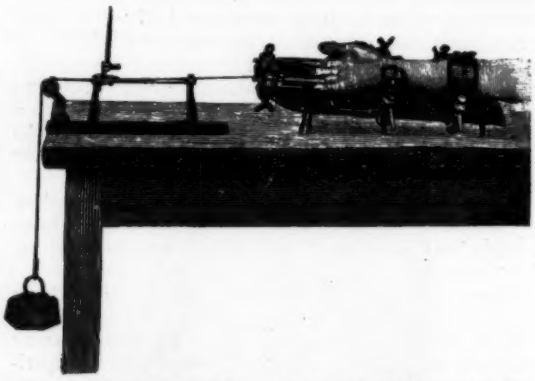

Fig. 1.—General view of the ergograph of Angelo Mosso (Arch. f. Physiol., 1890).

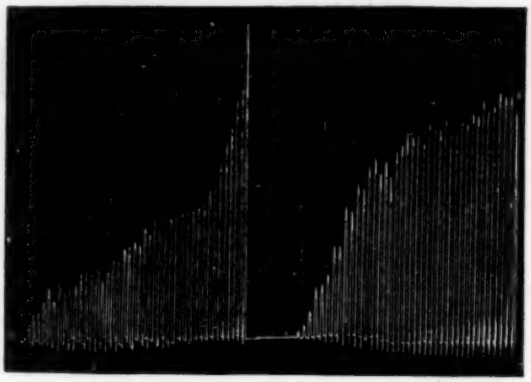

Fig. 2.—An ergographic record of fatigue of the muscles of a finger.

of work to lift the weight. The extent and character of these contractions were registered on a receiving drum.

Such tracings made by the leg muscles of the frog, or of some other cold-blooded animal, usually give the most typical pictures (Fig. 2).

Although these tracings are familiar to every student, there is one point about them, not always mentioned in the text-books, that is of clinical importance. It is known among physiologists as the *"Treppe,"* or "staircase."

As long ago as 1865 Ranke said: "Everyone knows that the first twitch of a muscle is not its greatest. With stimuli uniform in strength, the later contractions are stronger than the earlier ones—a phenomenon the reason for which has heretofore been wholly obscure."

In other words, when we look at tracings of this kind, taken together, they form, as it were, a series of waves. This is not so usual in the frog and other cold-blooded animals used in the laboratory to show the ergographic curves to the best advantage. It is found, however, quite frequently in the warm-blooded animals, and the effects are seen in the tracings with which we are to become acquainted.

III. OPHTHALMIC ERGOGRAPHS

1. *Definition.*—This term, "ophthalmic ergograph," is apparently the best for an instrument which measures the fatigue of the ocular muscles. It is nothing more than a combination of some appliance for producing fatigue of those muscles, together with a revolving cylinder or drum on which the degree and frequency of the muscular contractions can be registered.

2. *Varieties.*—There are two quite distinct forms of the ophthalmic ergograph. The first is an arrangement by which prisms are adjusted to the revolving drum. Such prisms measure only the fatigue of the extra-ocular muscles when the point of fixation is a candle, point of light, or similar object situated at least 6 meters distant. In this way efforts of accommodation in emmetropic eyes are eliminated. When the prisms are turned with their bases out, and measurement therefore is made of the action of the adductor groups, the arrangement can with propriety be called an adductor, or "convergence ergograph." Or, if the prisms are turned with their bases in, up or down, the same instrument becomes an abductor or divergence ergograph, or a superductor or subductor ergograph, according to the direction of the prisms.

Fig. 3.—Front view of the revolving prisms as arranged by Crété.

A second variety of the ophthalmic ergograph consists of an arrangement for measuring fatigue of the ciliary muscles. But that is not considered at present.[1]

IV. THE CONVERGENCE ERGOGRAPH

1. *Construction.*—A pair of Crété prisms (Fig. 3) (the original form of the Risley prism) is fastened by two clamps to the upright which supports the revolving drum. A delicate rod of brass is attached, near one end, to the pointer which slides over the drum. The other end of this rod, extending horizontally outward toward the drum, terminates in a point which records when there is blackened paper on the drum. Or, if a suitable pen is made fast at the end, this pen records when there is white paper on the drum.

For laboratory work, a chronograph, of course, makes the tracings more exact. One of these has therefore been used when accuracy was desired, and the notches at regular intervals are shown on some of the tracings. We shall see, however, that a chronograph is not necessary for ordinary clinical work.

2. *Preparation of the Ergograph for Laboratory Study.*—The blackened paper having been attached to the drum, the tracing point is made to touch the paper, and the drum is revolved once to mark the zero line around the drum. The pointer on the handle which slides along the scale is then pushed up to the mark indicating a prism-strength of 10 degrees, and a second horizontal line is run around the drum. Other horizontal lines are made to indicate a prism-strength of 20 or 30 degrees. Or, if great exactness is desired, we run other horizontal lines also at 5, 15, 25 degrees, or even at shorter intervals.

3. *Adjustment of the Subject to the Instrument.*—The person under examination is placed opposite a distant candle-flame, or preferably a point of light in a Thorington chimney. The head is held steady, or if the subject is restless we may make use of the ophthalmic head-rest. It is better, however, to do away with this or any superfluous appliances whenever possible. The drum is then moved into place. Experience has shown that the most convenient position for the subject is with his right eye looking through the prism, which is then arranged to measure adduction. As he does so he should see the distant light distinctly, and there should, of course, be nothing to obstruct the view with his other (uncovered) eye.

Fig. 4.—Prisms and revolving drum in position.

4. *Manipulation of the Apparatus.* — All preparations having been thus completed, the lever of the drum is released and the reading begun. The individual under examination himself, or the one who is directing the experiment, then slowly pushes up the pointer which is on the handle of the prism-case, thus increasing their strength. At the same time the examiner asks the subject to note whether he sees one light or two. As long as only one light is seen, the index is pushed up slowly but regularly. The moment two lights appear, the subject says "two." The pointer is drawn down promptly, the strength of the prisms at once reduced to zero, and the subject sees only one light (Fig. 4).

Again, a second time the pointer is pushed up slowly and regularly, thus increasing the strength of the prism until the subject says "two." Immediately the pointer is drawn down, the strength of the prism reduced to zero, and the subject sees only one light. This is done a third, fourth, fifth time, and so on. Not infrequently we find that a group of muscles which appears to be practically exhausted, suddenly and for some unknown reason seems to regain strength and the power of overcoming stronger prisms returns in response to renewed effort. Usually, however, the fatigue returns sooner than before, and sooner with each succeeding return of strength. These variations in power are examples of a *Treppe*.

1. The description of that instrument with the curves obtained with it was at first incorporated in this paper, and submitted with it, but as that made the article too long the consideration of the accommodation ergograph has been omitted.

It should be understood that when the ergographic tracing is taken of convergence in a pair of normal eyes in a young healthy person, quite frequently it is not possible to notice for some little time that any fatigue occurs. If, for example, the person is able to overcome a prism of 12 degrees in the first effort at convergence, he can perhaps continue to overcome this prism not only at a second or third effort, but after a considerable number of efforts. Indeed, it may happen that after the revolving combination has been gradually increased to this extent several times, there may be developed an additional strength sufficient to overcome a prism of 16 or 18 degrees, or more. But if the prisms are used with the ergograph, as described, persistently and carefully, after a time, in every case, distinct fatigue begins to show itself. The power of overcoming prisms tends to grow less and less, until finally it is reduced to practically nothing.

5. *Clinical Use of the Convergence Ergograph.*—The foregoing has to do with the use of the ergograph as a laboratory instrument. It is desirable to consider first the method which gives the most constant results, when tests are made of normal eyes. But, when using the ergograph for clinical purposes, several details can be altered or omitted without practical loss in efficiency.

The first modification which suggested itself was to dispense with the chronometer. When making exact tracings for laboratory work it is very satisfactory to have, immediately in front, the record of a clock which ticks seconds or fifths of seconds. But if the mechanism of the drum is properly arranged, it has been found to revolve at practically a uniform rate of once in about 340 seconds.

A second modification of the ergograph for clinical purposes is the use of a pen on white paper instead of a style-point on blackened paper. Every one accustomed to laboratory work appreciates the inconveniences necessitated by the blackening of a cylinder. We know how easily the surface becomes marred, and how necessary it is to fix the record in a shellac solution as soon as the tracings have been made. This inconvenience is obviated largely by the use of a specially made pen which holds a drop or two of ink.

A third modification is the drawing of the base-line only. The fact is that the mechanism which revolves the prism is such that the scale which marks a prism of 10 degrees is about 7.5 mm. above the zero line; the point on the scale which marks a prism of 20 degrees is about 15 mm. above the line; the point which marks the prism of 25 degrees is about 23 mm. above, and so on. Although this is a small detail, it is one to which a very considerable amount of time must be given, and for the busy practitioner each minute that any measurement requires is a minute given under protest.

6. *Measurements with the Convergence Ergograph.*—A. Tracings Made by Emmetropic Eyes in Healthy Subjects: In using the term "emmetropia" it should be remembered that this condition exists only in a small percentage of persons. In this connection, therefore, eyes were considered emmetropic when the ametropia did not exceed 0.75, and when tests of muscle-balance showed orthophoria or an esophoria of not over 2 or 3 degrees. Moreover, the persons selected have been those who have not suffered from what we understand generally as asthenopic systems. They have been in at least fair physical condition.

A word of explanation concerning the records is necessary. Where horizontal lines are drawn on the records, the first one represents the base-line, the second is drawn at the point where the index of the revolving prism marked a strength of 10 degrees, the next line at 20 degrees, and the upper one at 30 degrees. In a few of the tracings these horizontal lines are lacking. They could easily be supplied, if desired, by drawing them with the pen, but it seemed better to present the records just as they were. The fact is, also, that it requires only a little practice for one to judge by the eye with considerable exactness as to the strength of the prism which has been overcome, and the simple application of a millimeter measure shows practically the degree at any time. An average normal fatigue curve is shown in Figure 5.

B. Diurnal Variations in the Same Individual: Students of the ordinary ergograph learned long ago that the strength varied at different times and also under different conditions of health, as shown by the contraction of the finger. The renewed vigor which came after a meal or after sleep shows itself, not infrequently, in the ability of the muscles of the finger to contract longer than after the onset of general exhaustion. This is apparently the case, also, with the muscles of the eyes. For this reason the ergograph tracing or fatigue curve

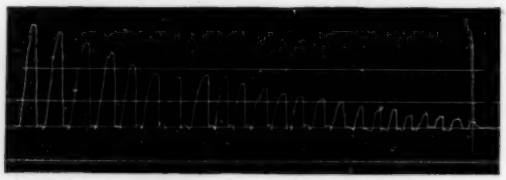

Fig. 5.—Fatigue of convergence in normal eyes.

Fig. 6.—Fatigue of convergence with variations in the power of adduction. An example of the so-called *Treppe.*

may vary from the example given in Figure 5, not only for different individuals within normal limits, but even for the same individuals at different times.

C. The Strong-Muscle Type: This variation from the ideal fatigue-curve is much more frequent than the weak-muscle type. The best examples are found in vigorous subjects. It is true, these resemble, to a certain extent, the tracings made with subjects who present typical symptoms of esophoria.

D. The Weak-Muscle Type: This is often found in pathologic conditions, but occasionally also in persons whose eyes are otherwise normal, and who have never suffered from asthenopic symptoms. There are two varieties of this weak-muscle type. In one, the muscles themselves have little power to make even a single effort; in the other the muscles soon become fatigued, or, even if moderately strong at first, they soon become exhausted.

E. Examples of the *Treppe:* In the introductory statements concerning the use of the ergograph, mention was made of the fact that in some persons the tracings showed that after fatigue of the muscles of the finger had begun, for some unknown reason, they seemed to regain their strength temporarily. This occurs also with the muscles of the eyes, as just mentioned. An

example of it is seen in Figure 6. This condition occurring in otherwise normal eyes and in persons with good health is interesting and suggestive. Although we know little of the causes, it is apparently the analogue, on a small scale, of conditions which we find constantly in the muscular system of the body as a whole, and of the eyes especially.

V. FATIGUE OF ABDUCTION

Thus far we have dealt only with the application of the ergograph to the adductor muscles, and have called the instrument, when arranged in this way, a convergence ergograph. But it is evident that by simply turning the revolving prisms around, bringing the bases toward the nose, and changing the mechanism so that the pen rests properly on the revolving drum, it is possible to make the abductor muscles write their record as the adductors had done before. Such a tracing is shown in Figure 7.

VI. FATIGUE OF SUPERDUCTION AND SUBDUCTION

Every student will remember that in the physiologic laboratory the ergograph was used quite as frequently with the drum in a horizontal as in a vertical position. Indeed, such instruments have an offset or foot near the top of the vertical bar, in order that such a change of position can be readily made.

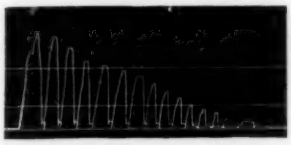

Fig. 7.—Fatigue of divergence.

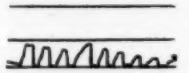

Fig. 8.—Fatigue of superduction with a tendency to the "*Treppe.*"

In other words, it is necessary only to raise the level of the table, or lower the chair on which the subject sits, and then, tipping the ergograph horizontally, to have the person under examination look with his left eye through the revolving prisms. The instrument is then an ergograph for measuring fatigue of sursum- or of deorsumvergence.

It is necessary, however, to exercise more care with the vertical muscles than when dealing with the horizontal groups, for even under normal conditions vertical diplopia is produced by a very weak prism (Fig. 8).

VII. FATIGUE OF ABNORMAL EXTRA-OCULAR MUSCLES

Thus far we have considered only the fatigue of practically normal eyes, but the student of this subject very soon finds that the tracings made by abnormal muscles are not only most varied, but full of interest.

At present it is only possible to state that these tracings resolve themselves into two great groups, belonging to muscles which are abnormally strong or abnormally weak.

1. *Excessive Convergence With Delayed Fatigue.*—At first glance it may seem incongruous to associate an apparent excess of strength with a pathologic condition. But as spasm of accommodation can be distinctly diagnosed by appropriate tests, and as Schmidt-Rimpler and others consider that certain degrees of such spasm are quite common, so do we meet occasional instances of spasm of accommodation with esophoria of quite high degree. And in these cases, when we take tracings with the convergence ergograph, we are apt to find a condition of "excessive convergence with the fatigue long delayed."

2. *Insufficient Convergence with Rapid Fatigue.*—We find here not only a low power of convergence, but that fatigue occurs promptly and soon passes into a condition of exhaustion. Another type is that in which the power of convergence is small at the beginning. The fatigue begins promptly, but, unlike the last, does not pass on to exhaustion. On the contrary, we have the same ability to continue short contractions for a long time as is found often in strong and healthy subjects.

Also, we have unusual variations in the same individual at different times, apparently as the results of treatment.

3. *Variable Pathologic Tracings.*—In some of these we find that the first few contractions point to the strong-muscle type. But as the contractions are repeated, the muscle soon begins to "run down." In other words, the condition is suggestive of that in which an apparently strong man succeeds in lifting a rather heavy dumb-bell, but after one or two efforts fatigue shows itself. Such muscles are weak rather than strong.

This condition is usually associated with one in which an apparent fatigue is followed almost immediately by the ability of the muscle to contract, at least for a few times, with considerable strength. Such muscles furnish examples of the *Treppe.* In this first communication it is possible only to describe the method of making ergographic measurements of the extra-ocular muscles, and to give a few of the average tracings obtained from normal eyes; also to indicate in the briefest manner possible what variations from that normal condition we may expect, when the extra-ocular muscles are in an abnormal condition.

It should be stated, however, that during the past few years many data have been collected to show more completely the tracings made by abnormal extra-ocular muscles, and also tracings made with the accommodation ergograph by normal and abnormal eyes. It is quite impossible, however, to present these data at present.

VIII. CONCLUSION

This ergographic method of measuring ocular fatigue gives us entirely new and apparently important data concerning the continued action of different groups of muscles. It shows us, for the first time, how fatigue occurs under normal conditions—what different types we may expect and what variations are not unusual.

We can now measure and record not only the initial strength of certain groups of muscles, but how long a given action can be continued without marked fatigue. In this way, by resolving the complicated problem which we call "eye-strain" into its different factors, there is more hope of solving it.

Thus a new field in the realm of ophthalmology opens before us. The probable value of the data which can be found there seems to warrant this preliminary communication concerning it.

NOTE.—Any who may be interested in the general subject of ergography will find the most complete list of references in the article by Zacharias Treves, "Ueber den gegenwartigen Stand unserer Kenntnis betreffend die Ergographie," Arch. f. d. ges. Physiol., 1901-1902, lxxxviii, 7. A careful examination of Nagel's Jahresbericht and of Ophthalmic Literature showed that no one had thus far described any form of ophthalmic ergograph, or made any tracings of fatigue of any of the ocular muscles.

522 Delaware Avenue.

ABSTRACT OF DISCUSSION

DR. CHARLES H. WILLIAMS, Boston: Dr. Howe's paper shows very well the effect of fatigue in reducing the energy of the contractions of certain sets of ocular muscles when responding to repeated efforts in the same direction.

The practical questions which concern us most is what is the resultant effect of fatigue on the six external muscles of each eye in altering the direction in which the axes of the eyes will stand, and how we can best measure the combined effect of those muscles on the position of the eyes. There are two conditions under which this muscular action must be studied, first, when the eyes are looking at an object at a distance of 5 meters or more, and the normal eyes should have their axes approximately parallel, and second, when the eyes are looking at an object at a reading distance of about 45 or 50 cm., and the axes of the eyes should be converged to that point. With the Maddox rods and candle there is an unconscious tendency for the muscles to turn the eyes so that the line of light seen by one eye will fall on a portion of the retina in the other eye on which the image of the candle is focused, and the line of light and the candle will, with small deviations, seem to coincide, and this defect is common to any form of test in which each eye sees only one object. Suppose, however, that one eye sees a row of figures and the other a single line; there is no tendency for the muscles to turn the eyes so that the line will stand over the number two, or the five or any figure in preference to the others, and the position which this line assumes on the row of figures may be used to determine whether the axes of the eyes are in their normal position or what the amount and direction of their deviation is.

At the meeting of this Section at St. Paul, I showed an instrument for measuring the position of the eyes at a distance of 5 meters which has worked so well and so quickly that it is used as a part of the routine examination of every case, and now I present a modification of this instrument adapted for a distance of 45 cm. or an average reading or writing position.

The smaller instrument, for the reading distance, can be used in an office while lighted with ordinary daylight, but for the larger one, where the light cannot be so intense, a darkened room is better.

DR. G. C. SAVAGE, Nashville, Tenn.: The study of the fatigue shown by the machine Dr. Howe exhibits develops three questions: 1. Is it mind fatigue? 2. Is it brain fatigue? 3. Is it muscle fatigue? It is one or another or all of these. The faculty of the mind controlling fusion is not volitional, and it is possible that this faculty grows tired of forcing the brain to accomplish the work of fusion. It is also possible that the brain center supplying the necessary neuricity becomes exhausted and is no longer able to supply the power. It is possible that the muscle grows weary in its work of turning the eye so as to keep the macula under the moving image. Leaving the mind and muscle out of the question, for the moment, I wish to discuss the brain center furnishing the neuricity for effecting the fusion. There are but three centers connected with the right internus (it is the right eye before which the rotary prism stands), namely: (a) the third center which is connected with both interni and is the convergence center, under the control of the will; (b) the fifth conjugate center, which is connected with the right internus and the left externus, and is the center which turns the two eyes to the left. This center is under the control of the will; (c) the right third basal center, which is connected alone with the right internus. If the fusion impulse is sent from the third conjugate center, the left eye would move in the convergence effort in harmony with the movement of the right eye. But does the left eye move? The image of the candle in the left eye is on the macula, and if the internus of that eye moves the eye, the macula must leave the image. The only reason why the right eye moves when the image is being displaced temporalward is that the macula may be made to follow the moving image. The left eye does not move; therefore the neuricity does not come from the convergence center. If the neuricity comes from the fifth conjugate center, the left externus will move the left eye in harmony with the action of the right internus, for the reason given above. The left eye does not move at all, and only the right eye is set in motion as its image is moved by the rotary prism. Hence, the fusion impulse does not come from the fifth conjugate center. If the fusion impulse comes from the right third basal center, all the neuricity is sent to the right internus, for this center is connected only with that muscle, and under the influence of this center the right internus contracts to the extent of its ability in its effort to make the macula remain under the moving image. No other muscle belonging to either eye is stimulated into activity. This power manifested by the right internus should not be called convergence power, but duction power. Convergence is volitional, duction is fusional and wholly involuntary.

DR. WENDELL REBER, Philadelphia: How long does it take to apply this instrument to the patient in the office?

DR. LUCIEN HOWE, Buffalo, N. Y.: About three minutes; when the examination is long it requires five minutes.

I am afraid I have not made myself clear. I tried to say at the outset that these measurements had nothing to do with the question of the position of the visual axes. Dr. Williams, I am afraid, has confused these measurements of fatigue with tests for orthophoria or heterophoria. It has nothing to do with them. The ergograph simply shows how soon a given group of muscles becomes fatigued.

As for the point raised by Dr. Savage concerning the condition of what he calls the neuritic battery, I must confess myself quite ignorant of all those hypothetical and theoretical questions. The ergograph writes its own story of definite data.

SUGGESTIONS REGARDING SOME POINTS IN THE TECHNIC OF CATARACT EXTRACTION

SAMUEL THEOBALD, M.D.

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BALTIMORE

Having, some years since, tried "simple extraction," and having, like most ophthalmic surgeons, abandoned it, I offer in this paper "suggestions" having to do with "combined extraction" only, for the uncouth procedure known as the Smith operation has never appealed to me. Indeed, though I may be wholly in error, I am more than half inclined to the belief that not a few of those who have adopted this procedure have been led to do so through dissatisfaction with their iridectomies, their lack of success in securing an approximately classical coloboma—perhaps the most difficult step in combined extraction.

THE INITIAL INCISION

Whatever differences of opinion there may be as to the location of the "corneal section" in simple extraction, there is in my mind no room for doubt that in combined extraction it should be, throughout, in the sclerocorneal juncture, and, further, that it is advantageous to secure a not-too-broad conjunctival flap. These ends can be best attained by using a Graefe knife with broader blade than was for many years in vogue and by the help of the double fixation forceps.

Such a section heals more readily than one which encroaches on the clear cornea, because the tissues divided are vascular, and for this reason, and because, too, of the conjunctival flap, it is capable of resisting more successfully possible bacterial invasion. Furthermore, it is not necessary with such a peripheral incision that it should include so considerable a part of the circumference of the cornea in order to secure easy expulsion of the lens; besides, with this section, it would

seem, there is less likelihood of permanent distortion of the corneal curvature.

THE IRIDECTOMY

The ideal iridectomy, as all will agree, is one which leaves a small, keyhole-shaped coloboma, with no entanglement of the iris in the ends of the corneal wound, and with the iris lying in its normal plane. That even the skilful operator not infrequently fails to secure this ideal result, all, again, perhaps, will admit.

At the meeting of the American Ophthalmological Society, in 1901, I exhibited what I have since called my reverse-curve iridectomy scissors. As then explained,[1] the purpose of this contrivance is to enable the operator to apply the concave surface of the blades — not their convexity, as is necessary with the ordinary curved iris scissors—to the convexity of the corneal limbus, whereby a better mechanical effect is obtained, and a cleaner, more perfect coloboma secured. It was further explained that the scissors were intended especially for the removal of a piece of iris by a single cut — as should always be done in cataract extraction — and are not well adapted to making a large coloboma by successive snips.

Extended experience with these scissors (Fig. 1) in the years which have since intervened, especially in extraction of cataract, has convinced me that they accomplish, most satisfactorily, just what was claimed for them. So I do not hesitate to commend their use to those who, like myself, attach importance to the securing of an ideal coloboma in combined extraction.[2]

Fig. 1.—Theobald's reverse-curve iridectomy scissors.

THE CAPSULOTOMY

The removal of a small portion of the anterior capsule has not seemed to me a matter of especial advantage, therefore I have never used the forceps contrived for this purpose. Instead, I have employed a Graefe cystotome, provided with a platinum shank, which permits of ready alteration of the angle of the shank, should this be found desirable.

A large rent in the anterior capsule is, I am sure, of decided advantage, since it not only facilitates complete extrusion of the contents of the capsule, but renders less likely later interference with vision from capsular obstruction. To secure such a rent, I make a long vertical incision, carrying the cystotome well beyond the lower margin of the pupil, and cross this with a shorter horizontal one. That this method really has advantages considerable experience has shown.

THE DELIVERY OF THE LENS

On this step of the operation I have only to remark that too strenuous or too persistent efforts to remove small remnants of cortical matter, especially if the cataract is mature or the patient well advanced in years, are, in my opinion, reprehensible, not only because of the attendant risk of loss of vitreous humor, but because, under such circumstances, these remnants will soon undergo absorption, and for this reason are not liable to give rise to unpleasant consequences.

That loss of "vitreous" has been a comparatively rare complication in my experience I attribute, in part, to my having acted in accordance with this suggestion; but, in still larger measure, to my having, for many years, always used the self-locking speculum devised by my late colleague, Dr. Russell Murdoch. That this instrument has not been more generally adopted by ophthalmic surgeons has long been inexplicable to me, for it certainly has many and great advantages. The chief of these are that it exerts a minimum amount of pressure on the eyeball; that—especially when the arms are somewhat more curved, as I have had them made (Fig. 2)—it interferes, practically, not at all with the operator in making the corneal section and in the subsequent steps of the operation, and that it can be quickly closed and removed, should any misadventure render this necessary. I may add that, as a rule, it is not removed until the operation is completed, that is to say, until the lens has been delivered, the iris dressed, and the conjunctival flap put in proper position.

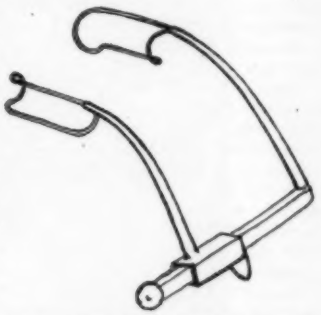

Fig. 2.—Murdoch's self-locking speculum

POSTOPERATIVE CARE

The most definite advance in recent years in the care of eyes after cataract extraction has been the employment of contrivances designed to prevent postoperative accidents.

There are a few patients possessed of such malicious and persistent ingenuity, whether awake or asleep, that "the best laid schemes o' mice and men" cannot prevent their bringing to naught — as every ophthalmic surgeon knows, to his sorrow — the efforts of the most skilful operator. Such malicious individuals have, in a few instances, succeeded in circumventing the immunity from accident commonly afforded by the protective shield contrived by Dr. Russell Murdoch, which I have used for many years; but, I doubt not the result would have been the same had the Ring mask, which is less acceptable to the patient, been used.

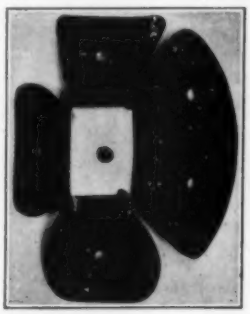

Fig. 3.—Murdoch's protective shield (slightly modified), for left eye.

A slight modification in the shape of the shield which I have made recently (Fig. 3), seems to possess some advantages over the original pattern. The shield is very light, being made of aluminum, permits of free ventilation—a point of importance—and is easily applied, and kept securely in position, by means of three strips of adhesive plaster.[3]

1. Tr. Am. Ophth. Soc., ix, 398.
2. The scissors are made by Meyrowitz, New York.
3. This shield and Dr. Murdoch's speculum are made by Charles Neubaus & Co., 510 North Eutaw Street, Baltimore.

970 North Howard Street.

A CASE OF UNIOCULAR POLYOPIA, EXISTING IN BOTH EYES

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Visiting Ophthalmic Surgeon, Boston City Hospital
BOSTON

Patient.—Dec. 5, 1902, V. W., a girl aged 14, was referred from the nervous to the eye clinic, Boston City Hospital, with the statement that she suffered from hysteria and complained of seeing double with left eye. The vision of each eye was found to be 20/50, and diplopia was found in nasal field of left eye. No paresis or paralysis of external eye muscle or muscles was noted.

Treatment.—December 10, homatropin was used for the purpose of testing refraction. With glass correction of —.75 sph. = —.50 cyl. axis 180′ over each eye, she was reported to me as seeing 20/20 —. The diplopia in left nasal field existed to same degree with and without such glass correction.

December 17: The diplopia had extended to nasal fields of both eyes. At that time the Maddox rod cut candle flame in vertical and horizontal meridians.

December 28: She alleged diplopia over the whole field of each eye.

Further Examination.—In the meantime, the usually named physical causes of such diplopia (incipient cataract, subluxation, iridodialysis, double pupillary opening, astigmatism, defective muscular balance) were sought, and no satisfactory reason for diplopia was thus secured.

Noting also Nettleship's statement that diplopia was met with in cases of brain tumor, she was examined with that in mind, the result being negative. Her fields of vision had been charted on December 12 and 19, and were found to be symmetrically contracted fully one-half.

Having failed to find physical cause for her complaint, I was reminded by Dr. Morton Prince that De la Tourette, in his "Traité clinique et thérapeutique de l'Hystérie," asserts that hysterical diplopia was caused by *spasm of the muscle of accommodation*, such partial ciliary contraction disturbing the refractive power of the lens.

I then had the patient use 1 per cent. atropin solution on December 29, 30 and 31, feeling that such mydriatic would relax any ciliary spasm. At the end of that time the diplopia was unchanged. The strength of the drug was verified, and its action tested on others.

At her first appearance at the eye clinic, I was informed that she had persistent muscular contraction of ankle and wrist muscles, and that a "magnet" would immediately restore wrist to its normal condition. The "magnet" was a harmless tuning-fork, but "suggestion" seemed to work perfectly.

Dr. Prince and I then thought hypnotic suggestion might dispel the diplopia. The patient was an easy subject, but the diplopia was unchanged after the trial. She was at this time seeing four objects, and was admitted to hospital and remained under observation on the medical service for some time. The polyopia remained unchanged to Jan. 8, 1903. She then complained of a severe head pain; after a few minutes there was what she called a "snap," and her vision was single.

It so remained until her discharge Jan. 17, 1903. Then her vision was noted as 20/100; with each eye —1.25 sph. = —.50 cyl. axis 180′ vision was 20/40, and Jaeger 2 at 17 to 45 cm. Exophoria of 2°— right cataphoria of 3′, was noted.

Jan. 23, 1903: While awaiting her turn for treatment at Nervous Out-Patient Department, she complained of pain in head and at once said that she saw double. I took her to my office and secured these results: With left eye closed she had diplopia in nasal field and across to temporal field of right eye. A pencil was seen double at 20 inches, both images on a level, upright and 1 inch apart. A candle flame at 17 feet was doubled, the images being about 2 inches apart.

With both eyes open she saw double. An 8-inch prism, base down, over right eye, with a red glass over left eye, gave her two white candle flames above and one red one below. Then she complained of a pain and a "snap" and immediately said she saw four objects.

I put an 8-inch prism, base down, over one eye; she at once said she saw two T's of test-type above, and two below. With prism, base down, on right, and red glass on left eye, she saw two white T's or candle flames above, two red ones below. Putting Maddox rod over left eye she got two flames with two vertical streaks about 2 inches to left of flames. A 1-inch prism, base in, brought lines through flames.

Jan. 24, 1903: I received a telephone message that the girl while at breakfast on that day had a severe twitching of lids; that when this ceased, pain supervened and she became blind. She was brought to me about 11:30 that morning. She was blind, she so remained until 12:30 o'clock. Then, while I was testing her for perception of light (her pupils without any mydriatic being dilated and non-responsive), she suddenly said that she could see. Everything in the room was described as "mixed up," and in a few minutes she was again blind. After a time she had perception of light in right, but none in left eye. Finally, when sight returned to the left eye, I had her read test-types. She saw four T's. With a double prism over the right eye (left being covered) she got two T's above, two T's below. With double prism over right and a red glass over left eye, she said she saw six candles; two white above, two red in the middle, two white below.

After a few minutes she had a spasm of orbicularis muscles, and her winking became very rapid for several minutes; a pain came on and she said she was blind. The lid-twitching grew too rapid to count; her face twitched, fingers and right leg became involved, and after about 20 minutes a "snap" came on, and she saw double with right but did not see with left eye. She had been blind from 1 to 3:45 p. m. After 15 minutes she had the old pain and "snap," and saw nothing. In that condition I had her go to Dr. Prince's office.

January 28: The girl was seen at Boston City Hospital. She then saw four candle-flames at a distance of 14 feet, the flames being 2 inches apart, this with the left eye covered. With right eye covered she saw four flames, 2 inches apart, at 14 feet.

With both eyes open and with red glass over left eye she saw eight flames, four white to right, four red to left, upright, and 2 inches apart.

With 10-inch prism over right eye she got four flames above, four below. With red glass over left eye, the upper images were white, the lower were red. With double prism over right eye (left being covered) she described four lights above, four below.

With both eyes open and with double prism over right and red glass over left she said she saw three rows of lights. After having had some difficulty in counting them, she described four white above, four red in middle and four white below. All were in line vertically and horizontally, being 2 inches apart laterally.

February 8: She said that the numerous images lasted until late in the day of January 28. On that day she had spasm of lids, face and limbs; then eyes saw singly until February 8, when left vision was single, right vision double.

March 16: My notes read: "No change. Right is still double, left is single. Much intolerance of light is present."

May 25: "Came to office. Intolerance of light lasted some time. Diplopia in right lasted until two weeks ago; now none exists. There is severe headache of late. She has had paralysis of limbs at times, keeping her in bed for days. Then she would be unable to move legs. At times she would have risus sardonicus, a turning of head from side to side, a turning of body on its axis, as if facing backward." (This description, save for my using the words "risus sardonicus" to explain the description of a "grin," was contributed by her mother.)

I found her vision to be:

O. D. 20/200; — 1.25 sph. = — .50 cyl. axis 180′ = 20/40
O. S. 20/100; — .75 sph. = — .50 cyl. axis 180′ = 20/40

Such correction was given for constant use. To a rough test the fields were found symmetrically contracted, but no diplopia could be found in any part of either field. I examined each fundus, as I had done on former occasions, and

found nothing abnormal, though the retinal veins seemed relatively larger than normal.

July 30: The mother wrote me that the girl had worn glasses constantly, received benefit from them, and had diplopia but once and for only an hour since she began wearing them. She described at length various body contractions and spasms, which have increased in severity.

October 20: The girl reported to me. She had had no diplopia since the date of the mother's letter. She had ceased going to hospital; had gone to a physician who diagnosed ovarian trouble, and she was going to a hospital for operation the next day.

Jan. 22, 1904: The mother called at City Hospital, saying the girl had been under an operation, that the ovaries were found much diseased and uterus retroflexed. The girl had been confined to bed for weeks by spasm or paralysis of lower limbs, but had had no double images since she visited me in October.

The many cases of polyopia noted in ophthalmic literature are well summarized by Ord and Adams, Gunn and Anderson,[1] Thompson,[2] Tilley[3] and DeSchweinitz.[4]

In several of these cases, paresis or paralysis of abducens was present. In three of the cases a post-mortem examination disclosed gross lesions in right cerebral hemisphere.

One of the cases, Adams',[1] was excluded, as spurious, and the author says:

Up to the present time I have never met with a case in which uniocular diplopia, in an eye that was physically perfect, was alleged to exist, except under circumstances where there was strong ground for doubting the validity of patient's statement.

Thompson says:[2]

The primary paretic squint and its necessary diplopia excited in a disturbed brain an impression which culminated in a true visual hallucination.

Abercrombie, in a case of monocular diplopia, in which a post-mortem showed a large abscess in region of lateral ventricle, says:

If each optic nerve is connected with cortex of both hemispheres of brain, then it is conceivable that in such a case as this the right hemisphere did not act in perfect unison with the left in interpreting impressions received on the right retina, whence her double vision; but on this hypothesis she ought to have double vision with left eye alone also, which she did not have.

In the present state of our knowledge we cannot say more than that she had an impaired power of visual discrimination.

Thompson[2] and Tilley[3] incline to Fontan's views expressed at the Ophthalmological Congress in 1885:

The image formed on the macula is received by the nerve which divides at the chiasm, so that two similar impressions are conveyed to the corpora quadrigemina, or implanted on the visual center at the cortex. Ordinarily the two pictures are united by a cerebral act or sympathy, which exists between the functions of the two brains. If, however, the joining of the two pictures does not immediately take place, two images is the result.

De la Tourette and Parinaud, in cases of hysterical polyopia, unreservedly give irregular contraction or spasm of the ciliary muscle as the cause of polyopia. Were such the case a lessening or removal of the spasm of accommodation should cause a change in the degree of the polyopia or its absolute disappearance.

It will be noted, however, that a prolonged use of atropin did not modify in the least degree the position of the images in this case. In the cases cited the monocular or binocular polyopia was constant, betraying no such lightning-like changes from single to double, or from double to multiple images, as noted in our case.

The contraction of ciliary muscle could hardly explain these phenomena, and still less could it account for the amaurosis which existed for part of a day. We are justified in assuming that hysteria is at the bottom of the case — we do not exclude the possibility of cerebral disease — but no explanation heretofore given accounts for her polyopia.

Wrist and ankle contractions in a young woman suffering from uniocular polyopia existing in both eyes.

LATER DEVELOPMENTS

The foregoing was written and read by me, in 1905, before the New England Ophthalmological Society, with Dr. Prince commenting on the case. Since then until March, 1912, my notes have reposed in an office drawer.

In 1906, the mother wrote me that the girl had been free from eye trouble (referring more particularly to double vision)

1. Ord and Adams: Tr. Ophth. Soc. U. Kingdom, II, 199; also Gunn and Anderson: ibid, iv, 292.
2. Thompson: Tr. Ophth. Soc. A. M. A., 1891.
3. Tilley: In same publication, 1892.
4. DeSchweinitz: Tr. Am. Ophth. Soc., 1894.

for over a year, save for one attack of double vision lasting half an hour. She added, however, that the girl suffered greatly from temporary paralysis of right leg and immobility of wrist for a few weeks after a heavy thunder storm. I lost all trace of the girl until a month ago; then I found her address, and asked mother and daughter to call at my office. They did so late in February, and I promised to examine the eyes of both after a short time.

On March 13 I wrote them to call, on which date I found the following:

R. V. = 13/200; — 1.50 sph. = — .75 cyl. axis 180′ = 20/30 +
L. V. = 20/200; — 1.25 sph. = — .75 cyl. axis 180′ = 20/30 +

She read with such correction Jaeger 3 at 8 to 10 inches, representing her near and far points. Color vision was good. The fields of vision were the same as in 1903, extending upward 20 degrees in each eye, 40 degrees outward, 35 and 40, respectively, in right and left eye below, and 35 and 30 inward.

NOTE BY NEUROLOGIST (DR. MORTON PRINCE).

March 13, 1912: The case of the patient, V. W., first seen by me in the neurological clinic, Boston City Hospital, in 1902, was then diagnosed as a perfectly typical, in fact classical, example of hysteria. She exhibited a large number of the usual stigmata. Among these stigmata were retraction of the visual fields, polyopia, temporary attacks of blindness and certain "crises," the exact nature of which I have forgotten at this time. Many of the symptoms would come and go with great suddenness. The contractures were easily removed by suggestion in the form of a fictitious magnet and could be reproduced with equal facility. This was frequently done for purposes of demonstration. The patient was shown to Dr. Pierre Janet, who was on a visit to Boston about that time, and he concurred in the diagnosis, about which there had never been any doubt. She was then lost sight of for a number of years.

This date (March 13, 1912) she was again examined, at the request of Dr. Bossidy, with the following result: Impaired sensation (including touch, pain and temperature) over the lower right leg in the so-called "stocking" form. The upper limit of the anesthesia was a little below the knee, but this boundary was not a symmetrical line but irregular. The left knee-jerk was normal but the right was absent. This very curious fact had been found when the patient was first seen in 1902. No explanation has ever been offered. Both plantar reflexes and both ankle-jerks were absent. There was no paralysis or contracture; no other physical stigmata. The diagnosis remains unchanged. (I did not tire her by using anything more than Priestley-Smith's simple ophthalmometer.) Her eyes internally appeared normal, save for slight relative increase in diameter of veins. The vision with glass correction was no poorer than in 1904. Her muscular balance was practically perfect. She tried to do fine sewing for three or four hours a day and her complaint of eye fatigue was due to the continued convergence of the eyes at 9 inches.

The illustration is from a photograph taken early in 1903, showing the wrist and ankle contractions. Up to 1903, when her ovaries were removed the patient had never menstruated, which must account for the hysteria; just as the latter may be the cause of the eye phenomena.

Dr. Prince and I agree that no explanation ever given for polyopia fits this case, and Janet of Paris, after seeing the girl in 1904, acknowledged that he disproved by her the theory of ciliary contraction.

We expect later to experiment on her, through hypnotism, trying to find in some childhood dreams or scares, as she will then show them to us, something to aid us in our search for a "cause."

She is bright, good-natured and strong-minded, and aside from some indigestion, in good health. Though pale, she is muscular, and may marry soon a man who knows all about her case. Will marriage lessen the hysteria of many years' duration by a lessening of her general nervous condition? We hope to be able to answer this question later.

419 Boylston Street.

ABSTRACT OF DISCUSSION

DR. A. E. DAVIS, New York: Monocular diplopia or polyopia, not due to some local condition of the eye, is of rather rare occurrence, and is a phenomenon thus far not satisfactorily explained. The local conditions giving rise to it are the following: (1) most commonly, incipient cataract; (2) irregular astigmatism of the lens, due to spasm of the ciliary muscle, or irregular astigmatism of the cornea, due to corneal opacities; (3) a new-formed or physiologic macula, in cases of squint of long standing following operation of straightening. This condition as a rule lasts but a few days or weeks at the most. The general conditions are (1) hysteria and (2) organic disease of the brain. The local conditions are easily understood, with the exception perhaps of the possibility of a new-formed macula in cases of squint of long standing. Dr. Verhoeff himself, in the endeavor to explain the occurrence of this monocular diplopia in such cases, assumed that "there are three centers in the brain almost entirely distinct from each other; one for the binocular perception of relief and two for monocular vision, one of the latter corresponding to the right, and the other to the left eye." Of course this explanation takes us from a consideration of the local to that of the general causes. I may say that Verhoeff's view in this respect corresponds in a measure with Fontain's as to the cause of monocular diplopia.

J. E. Adams pertinently asks: "Is it possible for a person with an eye in all respects normal as regards its physical condition to 'see double' with that eye, which means that a single retinal image is to give rise to a double mental impression?" Just how the double vision is caused, even where there is organic brain disease, is as yet a matter of theory and speculation.

After reading the present case, and reviewing others cited in literature we are forced to the view, excluding, of course, local eye conditions, that the vast majority of such cases are due to hysteria, and a few to organic disease of the brain. A striking coincidence in most of these cases has been a paresis or paralysis of the sixth nerve. Dr. Bossidy's case seems to be an exception as regards any weakness or paresis of the sixth nerve.

SOME EARLY DIAGNOSTIC RETINAL SIGNS OF ARTERIOSCLEROSIS AND CHRONIC BRIGHT'S DISEASE *

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The controversy that exists as to the identity of distinct types of chronic Bright's disease, such as chronic parenchymatous nephritis and chronic interstitial nephritis, continues, and by some it still is considered a debatable point whether the arteriovascular changes are primary or secondary to the renal changes.

McCrae[1] says that neither chronic parenchymatous nor chronic interstitial nephritis ever exists alone inasmuch as "interstitial change never exists without an accompanying parenchymatous change, and parenchymatous change cannot exist long without interstitial alteration following or accompanying it." He doubts the development of a primary contracted kidney.

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints. A copy of the latter will be sent by the author on receipt of a stamped addressed envelope.

1. McCrae in Osler's Modern Medicine, 1909, vi.

Strumpell[2] considers chronic interstitial nephritis as an atrophy of the renal parenchyma which begins in a previously healthy kidney and is not necessarily the ultimate termination of a chronic diffuse nephritis, though he describes a secondary contracted kidney which he considers simply a more advanced form of chronic diffuse nephritis. His distinction is further explained by the following taken from his description of the secondary contracted kidney:

> Since the kidneys in spite of their granulation have on the whole a normal size, we can infer from this and from the clinical course that they were previously enlarged. Therefore the name of secondary contracted kidney is quite suitable in opposition to the genuine contracted kidney which represents a much more chronic form of renal atrophy. In the latter the contraction takes place in an extremely chronic manner in a kidney which was previously normal, while in the secondary contracted kidney the cicatricial process develops in a kidney which was previously the subject of diffuse disease.

A similar view is held by Anders,[3] Edwards,[4] Kelly[5] and many others who might be quoted.

Dieulafoy[6] substantiates the view concerning the coexistence of interstitial and parenchymatous changes by saying that we may find glandular lesions complicated by interstitial and vascular changes, or interstitial and vascular changes complicated by glandular lesions. He believes that the nephritis taken as a whole is diffuse and that every case of chronic nephritis should be called Bright's disease whether the glandular or vascular changes predominate.

Herrick[7] says that morbid anatomists and pathologists are far from unanimous in their descriptions of the various types or groups of chronic nephritis, and that physicians are not always able to make a differentiation that is satisfactory from the clinical point of view, or that holds good in the light of post-mortem revelations. While admitting the coexistence of parenchymatous and interstitial changes in every case of chronic nephritis, and that the process in every case is really a diffuse one, he says:

> There are two groups of chronic inflammations of the kidney whose clinical features present such striking contrasts that one feels warranted in making separate classes of these groups, and the justification of this seems apparent when one sees that corresponding to these two types kidneys are found differing as markedly as do the clinical manifestations. To the one form, characterized by edema with abundant albuminuria and cylindruria, the name chronic parenchymatous nephritis has been most often applied; and to the other, with its marked cardiovascular changes, its relatively slight albuminuria and cylindruria, with its abundant urine of low specific gravity, its frequent uremia, the term chronic interstitial nephritis is given. Often, however, the disease refuses to conform to the picture of a classical type, though there are enough of the fairly typical cases to justify the classification that has been made.

Between these two extreme types described by Herrick[7] and many others, we have numerous varieties of intermediate types which Dieulafoy[6] calls mixed nephritis, and these constitute the most frequent form of Bright's disease. Dieulafoy has also coined the word "Brightism," which he applies to the mild form of chronic Bright's disease in which the urinary depuration is insufficient, and mild symptoms only are present.

Concerning the relationship of general arteriosclerosis to Bright's disease, much has been written. Sutton and Gull[8] advanced the theory that lesions of the small contracted kidney are due to a local form of general arteriosclerosis, and to this morbid state they gave the name of arteriocapillary fibrosis. Dieulafoy[6] says that this theory of general arteriosclerosis, which has been confirmed by many post-mortem examinations, does not explain all the cases of nephritis in which the arteries are chiefly affected, and he quotes Brault to this effect:

> Instead of subordinating the lesions of the kidneys to the general arteriosclerosis, it is more rational to subordinate the lesions both of the kidneys and all other organs to one prime cause (gout, lead, old age, heredity, etc.). Besides, the importance of the arterial lesions in their relation to the contracted kidney has been much exaggerated.

Herrick[7] considers the cardiovascular changes of great importance from the standpoint of the diagnosis, and says that it is a rare thing to find a case of chronic interstitial nephritis permitting of diagnosis in which the cardiovascular changes are not more or less well pronounced. But he further says that "differentiation between the primary nephritis and the secondary arteriosclerotic vascular and cardiac changes may not be possible."

Edwards[4] says that the etiology of chronic interstitial nephritis is essentially that of arteriosclerosis, with which contracted kidney has a threefold relation; (a) arteriosclerosis may cause the arteriosclerotic kidney; (b) contracted kidney may cause arteriosclerosis, or (c) both may result from a common cause. The noxa or toxin reaches the kidney through the blood-stream.

Anders[3] says that arteriosclerosis and Bright's disease may develop independently of one another, and yet simultaneously in consequence of the action of a common cause. He considers chronic interstitial nephritis as but one lesion of a generalized process of fibrosis.

Kelly[5] says that chronic interstitial nephritis should not be considered as a disease of the kidneys alone, not even primarily, but a disease of the cardiovascular system, and that there is always a more or less wide-spread arteriosclerosis, hypertrophy and later dilatation of the heart.

Strumpell[2] says that the theory advanced by Gull and Sutton[8] and others that the vascular disease always represents the primary process to which the renal atrophy is only secondary, is untenable, and says that we often find a most pronounced contraction of the kidneys without any vascular changes sufficient to explain the atrophy.

Roderer[9] says that chronic interstitial nephritis is an inflammatory disease of the arteries. He further says that when the inflammation of the blood-vessels in the kidneys extends to the parenchyma of the kidneys, then an examination of the urine will show casts and albumin. The fact that the examination of the urine shows disease, he believes to be the reason that chronic interstitial nephritis has been called a disease of the kidneys.

Ophüls,[10] in discussing subacute and chronic nephritis, as found in 1,000 selected necropsies, says that Gull and Sutton[8] deserve great credit for having first suggested that there is a disease in which the arterioles throughout the body are altered, which constitutes the general morbid change of which contraction and atrophy of the kidneys are part and parcel. He concludes with the statement that a careful study of his necropsies cannot leave room for doubt in regard to the fact that the ordinary

2. Strumpell: Text-Book of Medicine, 1912.
3. Anders: Text-Book of Medicine, 1909.
4. Edwards: Text-Book of Medicine, 1909.
5. Kelly: Practice of Medicine, 1910.
6. Dieulafoy: Text-Book of Medicine, 1911, ii.
7. Herrick: Osler's Modern Medicine, 1909, vi.
8. Sutton and Gull: Medico-Chirurgical Transactions, 1872, lv.
9. Roderer: THE JOURNAL A. M. A., April 22, 1911, p. 1222.
10. Ophüls: Arch. Int. Med., February, 1912.

red granular, contracted kidney is the result of general arteriosclerosis, and that in many of these cases the general arteriosclerosis is much more important in regard to the condition of the patient than the renal lesion which he may have at the same time. He further says that general arteriosclerotic lesions develop coexistently with arteriosclerotic lesions of the kidneys, but that there is no strict interdependence between the two processes. His conclusions are as follows:

At the present time in many cases too much attention is paid to the kidneys clinically and anatomically. The so-called primary or genuine contracted kidney represents a disease of the kidney which is the result of arteriosclerosis in the terminal arterioles in this organ, is closely associated with general arteriosclerosis, and cannot be properly understood without due consideration of this fact.

The relation of hypertension of the arteries and enlargement of the heart to arteriosclerosis and chronic Bright's disease has also been the subject of extended study. Thus Dieulafoy[6] says that cardiac lesions may exist in all forms of chronic nephritis, but that the lesions do not always show themselves by hypertrophy of the heart, and he lays great stress on this point because it is too often said that the heart is always enlarged. The heart may be smaller than normal and may at first sight appear to be healthy, yet histologic examination shows advanced arteriosclerotic changes. "Very marked hypertrophy may coexist with very moderate arteriosclerosis, and reciprocally the arteriosclerosis may be advanced while the heart is not hypertrophied." He concludes with the theory that the cardiac hypertrophy is not due to the sclerotic lesions but to the increased arterial tension caused by the more or less general arteriosclerosis and the contraction of the small vessels due to toxic influences, a view also entertained by Strumpell.[2]

Edwards[4] says that high tension is one of the most constant and early symptoms of chronic interstitial nephritis (a view also entertained by deSchweinitz), and its early occurrence leads some writers incorrectly to regard contracted kidney as a disease of the arteries rather than of the kidneys.

Kelly[5] says that increased blood-pressure is an early and valuable sign, and that arteriosclerosis, accentuation of the aortic second sound and hypertrophy of the heart, especially the left ventricle, may be found in all forms of Bright's disease, but in none of the forms do they so dominate the clinical picture as in primary chronic interstitial nephritis.

Jones[11] maintains that hypertension is the primary trouble that leads to both cardiac hypertrophy and general arteriosclerosis, and that hypertension of the arteries, such as sometimes exists in valvular disease, does not apparently lead to arteriosclerosis but to hypertrophy of the media of the small arteries. He also contends that general arteriosclerosis cannot be the direct cause of the hypertension which produces the cardiac hypertrophy. He believes that general arteriosclerosis is invariably of toxic origin, which explains the evidences of inflammation of the larger arteries and in the kidneys.

Taussig,[12] in discussing arterial blood-pressure, says that it is astonishing how often we find pressures normal or subnormal in patients with greatly thickened or even calcareous arteries. He gives as one of the conditions responsible for the occurrence of hypertension, toxins that directly raise blood-pressure and at the same time have an injurious effect on the arterial wall. Where the action of these toxins is long-continued, the persistent hypertension caused by them will lead to general arteriocapillary sclerosis.

While opinions may differ as to the exact relationship existing between general arteriosclerosis and chronic Bright's disease, the fact remains that there are certain manifestations and signs more or less common to the two conditions, and evidence seems to be accumulating in favor of the theory advanced by Gull and Sutton[8] that chronic Bright's disease, and in particular that type of the disease which has been termed chronic interstitial nephritis, is a manifestation of general arteriosclerosis in which the kidney symptoms are the predominating ones. Furthermore, as Dieulafoy[6] and more recently Ophüls[10] have pointed out, no advanced general arteriosclerotic changes exist without an inflammation of the kidney to a more or less extent. Whether the renal lesion will be a predominant factor depends entirely on the condition of the kidneys and their power to resist the effect of the toxin which is the causative factor in the production of the vascular alteration.

The hemorrhagic retinitis of a general arteriosclerosis, and the typical albuminuric retinitis of chronic Bright's disease are familiar pictures described in text-books, but it is to the less-pronounced retinal lesions which may or may not attract the attention of the patient, and which appear early in the history of the disease, to which attention is especially directed. These lesions, frequently overlooked or misinterpreted, and often discovered by accident, are sufficiently suggestive to warrant a suspicion of general arteriosclerotic changes with accompanying kidney inflammation, and the propriety of more extended study of the case.

Some of these earlier retinal changes and especially those in a more advanced state have been described by numerous writers. Thus Alleman,[13] in discussing the retinal symptoms of vascular degeneration, mentions spasm of the retinal vessels as shown by localized transient contractions, (also reported by Zentmayer[14] and Greenwood[15]), tortuosity of the smaller retinal vessels, and a multitude of minute glistening dots in the retina, which occur during the period of high pressure and disappear with the return of the normal arterial pressure. Weeks,[16] in describing arteriosclerosis of the retinal vessels, mentions the delicate white lines at the borders of the arteries in the greater number of cases, loss of transparency of the vessels, and the appearance of hemorrhage and exudation. In discussing albuminuric retinitis, he divides the condition into two classes: (1) those cases not preceded by thickening of vessel-walls, which will include cases occurring as a result of acute parenchymatous nephritis in which the changes in the kidneys precede those that occur in the retina; (2) those cases in which the hemorrhage and exudation are preceded by changes in the walls of the vessels (arteriosclerosis), and in this class are those cases accompanying chronic interstitial nephritis in which the changes in the retina may precede the appearance of albumin in the urine.

In discussing the retinitis of Bright's disease, deSchweinitz says that small, discrete and sharply separated white spots, which appear most numerous in the region of the macula, are among the early signs. Again he says, in the consideration of high arterial tension,[18] that if the cause of persistent high arterial tension

11. Jones: Deutsch. Arch f. klin. med., 1908, xciv.
12. Taussig: Interstate Med. Jour., June, 1911.
13. Alleman: Am. Med., February, 1904.
14. Zentmayer: Tr. Sect. on Ophth. A. M. A., 1906.
15. Greenwood: Tr. Sect. on Ophth. A. M. A., 1904.
16. Weeks: Treatise on Diseases of the Eye, 1910.
18. de Schweinitz: Ophth. Rec., August, 1906.

is sufficiently prolonged, retinal alterations will occur at any age at which the pathologic condition necessary to excite them may arise. He describes three early indications, viz., (1) a markedly cork-screw appearance of certain arterial twigs; (2) a flattening of a vein where it is in contact with an artery; (3) an appearance of the nerve-head often loosely described as congested. Concerning the significance of the signs, he says that they have more than a local significance, and one of the most important indications is that which refers to arteriosclerosis. He calls especial attention to the increase of the blood-pressure as an early symptom, and says that hypertension is not infrequently the first sign of beginning renal or vascular degeneration.

While the more pronounced retinal lesions in general arteriosclerosis and chronic Bright's disease have been frequently described, but little reference, other than that here quoted, has been made to some of the very earliest manifestations, and in particular to the diagnostic importance of these early lesions when associated with hypertension of the arteries. While deSchweinitz[18] apparently makes a distinction between the retinal lesions of general arteriosclerosis and chronic Bright's disease, he describes lesions that are common to both and which are accompanied by hypertension which seems to be an etiologic factor. In the conclusions on which this paper is based emphasis will be placed on the supposed fact that the very early retinal lesions are always due to toxic influences and attending, persistent, comparatively high blood-pressure, whether the process is eventually to show the nephritic symptoms to be predominant or not; and further, that the very earliest retinal manifestations do not give any decisive information as to what direction the disease will take later.

Particular attention is here directed to the almost indistinguishable small white dots, few or perhaps many in number, which appear in the neighborhood of the disk, and most frequently in the macular region; the haziness and often a delicate hyperemia of the disk; isolated, faintly milky colored areas in the retina; the beaded appearance of some of the larger vessels and alteration in the character of terminal vessels (the cork-screw appearance described by deSchweinitz), and, as important as any indication, the appearance of scotomas either with or without visible retinal alteration. Any two or all of these lesions may coexist, and any one or all may exist with but little or no alteration in the vision as detected by the patient. Usually, however, the patient detects a slight impairment of the vision which prompts him to seek relief, or, as is frequently the case, the condition of the retina and its effect on vision are discovered by accident, as in the routine examination for glasses.

As has been pointed out by Ophüls[19] and others, it is difficult, if not impossible, to draw any distinct line of demarcation between general arteriosclerosis and chronic interstitial nephritis, for while clinically one or the other may seem to be of most importance, autopsy seems to show that the two conditions are present together, and that they both come under the heading of arteriovascular change, due to some toxin. It is equally difficult to say whether the eye lesions under consideration should be considered as a manifestation of general arteriosclerosis either in which the nephritic symptoms are to be more or less pronounced, or in which the nephritic lesion is secondary and of minor importance, inasmuch as the early retinal lesions are common to both types of cases. That these eye lesions, perhaps, are not always present is admitted, but from the facts that arteriosclerosis is generally found to involve the terminal arteries, and that the retinal tissue is particularly susceptible to toxemias, it is quite possible that the lesions may be found in a large percentage of cases of arteriosclerosis if they are looked for by a painstaking ophthalmoscopic examination by the direct method with the patient's pupils fully dilated. When found, as they often are accidentally, they are of much diagnostic and prognostic importance and should lead to such attention of the patient as will tend to retard the progress of the general process.

The coexistence of a relatively persistent high arterial tension is especially significant, as pointed out by deSchweinitz,[17] for the retinal signs under consideration go hand in hand with the continuous high arterial tension of arteriosclerosis, and when coupled with such urinary findings as a low specific gravity and even the occasional appearance of casts, the diagnosis is more complete. Cardiac hypertrophy and accentuation of the aortic second sound are manifestations which occur late, as a rule, and only add to the significance attached to the earlier findings.

Stengle[22] recognizes the importance of ophthalmoscopic examinations in high blood-pressure cases when he says that the ophthalmoscope may reveal positive evidence of vascular disease.

The accidental discovery of the lesions justifies the opinion of Marple,[23] who says:

> It cannot be too strongly emphasized that examination of our middle-aged patients for glasses should not be done in a perfunctory manner, but that the condition of the retina should be carefully investigated. Such an examination cannot be made by the indirect method, and not seldom a mydriatic must be used.

The importance of noting the condition of the retinal vessels is also emphasized by Coates,[24] who says that retinal change remains the best indication of the state of the vessels generally which we possess.

We must not, however, forget that similar lesions arise from other causes. Thus Bichelonne[25] reports a case of neuro-retinitis (without hypertension) simulating albuminuric retinitis, occurring in a healthy man, aged 22, after almost continuous writing for two days and nights. The case ended in steady and complete recovery, but the suggestion is made that we should bear in mind that in renal retinitis eye-strain may be a very important causative factor. With due propriety it may be added that the eye lesion, even though significant, should not be considered alone in arriving at an opinion as to the etiology and pathology of the condition.

The part played by high blood-pressure in the production of these lesions is attested by deSchweinitz,[18] who calls attention to the increase of blood-pressure which always accompanies the early stages of arteriosclerosis, and he emphasizes the utility of the sphygmomanometer. It is also discussed by Barker and Haines,[26] Black,[27] Jackson,[28] and Barrett.[29] The latter, in discussing the ophthalmoscopic appearances with high blood-pressure, relates the case of a woman of 23 years with a blood-pressure of 240 mm. of mercury, and entire absence of ophthalmoscopic changes, who many months later showed abundant evidences of albuminuric retinitis, which would

22. Stengle: Am. Med., Jan. 2, 1904.
23. Marple: Med. Rec., March 16, 1907.
24. Coates: Ophthalmoscope, 1906.
25. Bichelonne: Ann. de Ocul., December, 1904.
26. Barker and Haines: Am. Jour. Med. Sc., 1909.
27. Black: Tr. Sect. on Ophth. A. M. A., 1908.
28. Jackson: Colorado Med., February, 1910.
29. Barrett: Australian Med. Jour., 1910, xv.

seem to indicate that the retinal lesions occur only after persistent high blood-pressure.

The theory that hypertension may precede the general arteriosclerotic changes seems borne out by the findings of Ophüls,[10] who considers the increase in the blood-pressure as due to toxic influences, a view that is also entertained by Jones.[11] In support of this view, Widal[30] considers the retinitis as being ureic, and zur Nedden[31] accounts for an involvement of the retina in nephritis through cytotoxins developed in the kidney. Schieck,[32] in discussing renal retinitis, says that he has found marked changes in the nervous elements of the retina but no trace of alteration in the blood-vessels; and Shiba[33] contends that the condition is due to some alteration in the state of the blood.

Concerning the effect of the earlier retinal lesions of arteriosclerosis on vision it is readily understood that the size and the location of the lesions have much to do with the extent of visual disturbance. In those cases in which there are spots or milky patches in the region of the macula there is usually some failure of vision, whereas in those cases in which the lesions are small and away from the macular region there may be no disturbance of vision noticeable to the patient or determinable by chart tests, though the perimeter will disclose scotomata. In fact, relative scotomata, varying in shape and size, often may be discovered in those cases in which there are persistent high blood-pressure and but faint ophthalmoscopic signs in the retina to account for the lesion. It is assumed that the scotomata are produced by the same toxic influences, acting through the blood, and affecting the nervous elements of the retina, which are responsible for the hypertension and later the arteriosclerotic changes. It is also quite probable, as Garrod[34] says, that the toxin, in a sense, is of uremic origin, for there need be little hesitation in asserting that high arterial tension is a natural outcome of uremic poisoning.

While the retinal lesions, coupled with a persistent, relatively high blood-pressure, alone are significant of arteriosclerosis, the urinary findings add materially to the certainty of the diagnosis. The presence of albumin and casts in the urine has long been recognized as of great diagnostic importance when associated with other symptoms, though Dieulafoy[6] thinks that their importance has been exaggerated. He further says that hyaline casts are unimportant, though granular casts always indicate a lesion of the kidneys. McCrae[1] says that a hyaline cast is an indicator of disease, and Garrod[34] contends that hyaline casts indicate the slightest degree of renal mischief. The retinal lesions under consideration frequently occur before there are urinary findings of significance, and it is only later that albuminuria and casts, especially granular, are found in the urine, and then the retinal lesion is also advanced so that the picture is quite characteristic and in keeping with classical text-book descriptions.

The value of the sphygmomanometer in determining the blood-pressure in eye cases has been emphasized by numerous writers including deSchweinitz,[18] Dunn,[35] Black,[27] Barker and Haines,[26], Semple,[36] Veasey[37] and others. Jackson,[28] in discussing blood-pressure from the standpoint of the ophthalmologist, says that not only should ophthalmoscopic symptoms of increased blood-pressure lead to the use of the sphygmomanometer, but an elevated reading with the sphygmomanometer should call for an ophthalmoscopic examination.

The fact that eye signs are often detected during the course of an examination for the correction of refractive errors, or may be discovered otherwise in an accidental manner, shows the importance of giving all cases coming into the hands of the ophthalmologist a careful opthalmoscopic examination, and many general physicians may obtain corroborative evidence in their arteriosclerosis cases by obtaining a report as to ophthalmoscopic findings. The further fact that these ocular signs are among the very earliest symptoms, susceptible to detection by careful examination, is important from a prognostic standpoint, because the earlier the diagnosis can be made the more probable it is that good results will be secured from treatment.

219 West Wayne Street.

30. Widal: Ann. de Ocul., 1910, cxliii.
31. zur Nedden: Arch. f. Augenh., 1909, lxxiii.
32. Schieck: Wien. med. Wchnschr., March 14, 1908.
33. Shiba: Klin. Monatsh. f. Augenh., April, 1908.
34. Garrod in Osler's Modern Medicine, vi.
35. Dunn: Arch. Ophth., November, 1908.
36. Semple: Am. Jour. Ophth., January, 1910.
37. Veasey: Jour. Ophth. and Oto-Laryngol., May, 1911.

ABSTRACT OF DISCUSSION

DR. F. T. ROGERS, Providence, R. I.: The detection of slight ophthalmoscopic changes, such as have been described by the essayist, is largely influenced by the personal equation of the examiner, and too much stress must not be laid on changes in the color of the arteries, brilliancy of the light streak, tortuosity of the vessels or loss of translucency, as these details are always comparative, and what may be apparent to one is not always visible to equally competent observers, and if there is a loss of vision without apparent cause it is easy to imagine that any one of these conditions may be present, and to it may be ascribed the diminution of sight.

I would add to the danger signs enumerated by Dr. Bulson changes in acuity of vision, whether or not associated with a fundus lesion. I do not believe that the problem will be solved without the presentation of proof attained by a collective investigation and a study of carefully kept case records. You and I may believe that we can detect in the fundus signs of approaching arteriosclerosis, but the majority of the profession do not, and demand proof.

Last year at Los Angeles I reported on the subsequent histories of a large number of cases of retinal hemorrhage, and each case had been carefully traced over a period of from three to ten years, and if living the present condition of the patients' health was noted, and if dead, the cause of death. I found that 80 per cent. of these individuals died within a few years or suffered from ill health, and that nephritis or arteriosclerosis was the exciting cause in three-quarters of them. Yet, when I argued that these findings warranted the assumption that even slight retinal hemorrhages, whether due to diapedesis, rupture or inflammation, were worthy of our attention, exception was taken by several members who stated that they did not believe the condition was at all serious, because they had seen many cases, and so far as they knew, the patients were in good health. The trouble was, they did not know, and the two or three cases reported by Dr. Bulson are worth a thousand reported from memory as in good health, so far as they know.

Gentlemen, this is no dream; there is a period preceding the invasion of disease, a period of incubation as distinct as the aura of migraine, and nowhere is it more likely to be seen than in the delicate structure of the eye, and our success depends more on an ability to detect these premonitory signs and to prevent, than to diagnose the well-developed condition and to attempt to cure it.

If Dr. Bulson's essay will call attention to this it is well worth while. If it should result in a systematic effort on the part of this Section to collect and publish the results of a collective investigation, it would prove beyond contention the essayist's statement that the recognition of these early symptoms will result in the saving of life.

DR. S. D. RISLEY, Philadelphia: The association of certain ocular affections with kidney disease furnishes one of the most critical and important chapters in ophthalmology, since the question of a more or less serious prognosis is always presented.

The almost constant association of cardiovascular disease adds not only to the complexity in such cases, but to their gravity. It is not always certain that the retinal disease is secondary to the affection of the kidney, since in the early stage the retinal edema, the full and tortuous veins and the beginning sclerosis of the retinal arteries, accompanied by high blood-pressure and other evidences of general cardiovascular disease, together with kidney derangement, are probably common phases of a general disorder, which finds its beginning in the general vascular tree. I have seen many examples of the very serious character of this symptom-complex from the standpoint of prognosis, in patients with failing vision, presenting the ophthalmoscopic picture I have described, but who considered themselves in good health. In one striking example, the man came for a change of glasses to aid his impaired vision, refused to seek the advice of his physician, claimed that he was in perfect health, but nevertheless suffered an attack of cerebral apoplexy ten days later. It is no uncommon experience to find ophthalmoscopic evidence of high arterial tension, in patients with headache, impaired vision, urine with high specific gravity, a trace of albumin, indican present, hyaline and granular casts. In these early stages of arteriosclerosis before atheroma of the arteries has advanced, there is danger of rupture of the blood-vessels. There are frequently hemorrhages in the retina and chorioid. It is important for us as ophthalmologists not only to recognize these cases, but to recognize them in their relationship to cardiovascular disease, of which both the kidney affections and the ocular symptoms are but a sign.

DR. OTTO LANDMAN, Toledo, Ohio: Barker of Johns Hopkins, in a paper published a few years ago, was one of the first writers to call the attention of the profession to the fact that we can have an exophthalmos with high arterial tension and fatal lesions of the kidney without any decided changes in the retina. A short time ago I saw a patient who was referred to the family physician, who published a report of the case. This woman had been a patient of mine for a number of years and had a refractive error. She was the mother of a child of about 1½ years of age. She came complaining of headaches and some dizziness, and thought perhaps that there was a necessity for changing the glasses. I examined her carefully, and concluded that it could not be the glasses that were producing the trouble. She was myopic, had a posterior staphyloma, but there were no retinal changes. Usually I make an examination of the kidneys and take the blood-pressure. The blood-tension at that time was 280. She was about 27 years of age. There was a marked exophthalmos, and examination of the urine showed that she had a marked nephritis. Had I not known that albumin was present and that there was associated with this a high arterial tension, I should have declared that the fundus was normal; but there was just a slight haziness of the disk, and I concluded that that was the result of high tension or changes in the vessels, but I could find no such changes whatever. She had a compensatory cardiac hypertrophy and in eight months she was dead. What I would like to know is how frequently we find exophthalmos associated with high tension and renal changes?

DR. ALLEN GREENWOOD, Boston: An important part of the work of the ophthalmologist is the examination with the ophthalmoscope of the fundi in every case that comes before him. We should bear in mind that we may frequently find in the examination of the fundi of our presbyopic patients early changes in the arteries when there is absolutely no evidence of any trouble, general, or in the kidneys; but it has been my experience if these early changes are found that the patient sooner or later will develop changes in the kidneys.

Nine years ago I published a paper on albuminuric retinitis, and a year later read before this Section a paper on obstructions of the retinal arteries, so that since then I have followed this subject of arteriosclerosis with interest. In my work at the Boston City Hospital, besides the ordinary eye clinic, I have to look out for all the consultation eye work for nearly a thousand ordinary bed patients, and so see a good many cases of arteriosclerosis in the early stages, accompanied by high arterial tension, and hardly a day passes in my private practice that I do not send a letter to the family physician of some patient stating that I find this condition. I think physicians to-day are awakening to the importance of these suggestions from ophthalmologists, and this thorough examination under some mydriatic of every patient with presbyopia for lesions of the vessels of the fundus is one of the important services we can render to the community.

DR. WENDELL REBER, Philadelphia: The phase of the subject on which I wish to speak is the significance of the earliest symptoms. I was interested in what has been said about people who come in for correction of their refraction. The pressure in the retinal vessels in many cases is practically normal. When that has once been ascertained, the deviations can be easily determined. The ophthalmologist often sees the first changes before the internist expects them. On the other hand, we must not forget the dictum of Olvier, that arteriosclerosis is a general disease with a tendency at times to localize itself; so that we may not see retinal changes, and yet there may be marked retinal disease. This occurs oftener than we believe. I am inclined to believe that the general practitioner is growing wiser, and we do not see the changes first as often as we used to, in the prenephritic stage, when we can be of the greatest service to the patients; that in that which precedes, which Dr. Risley has called the physiologic vices of this day and generation, producing high blood-pressure, in a study of the arterial and venous crossings of the fundus we have failed to seek for the little localized areas of edema of which Dr. Bulson speaks. These are found before the stage of the cork-screw artery or the brick-red disk. Another class of cases which I have had the pleasure of studying is incipient locomotor ataxia, which shows elongation in the arteries and veins. It is one of the commonest observations in my office. Presbyopes who show unequal accommodation and sluggish pupils will almost invariably show pressure at the retinal vein crossings. I agree thoroughly with Dr. Rogers in the matter of individual interpretation in the early stages of this disorder. If the index of refraction is normal, we do not see the walls of the vessels in the retina, but the color of the blood column, and only when diseased do we see the vessel itself. The moral of the paper is that the early changes are the important ones, for once established these patients are doomed; not necessarily in two years, but they are doomed to a life of reduced efficiency and will frequently be compelled to retire from active life, and there is little we can do to restore them to their full efficiency.

DR. ALBERT E. BULSON, JR., Fort Wayne, Ind.: My principal object in presenting the paper was to call attention to the very early ocular manifestations of arteriosclerotic changes, whether such changes are known as general arteriosclerosis or chronic Bright's disease. We all have made diagnoses of well-marked albuminuric retinitis and hemorrhage retinitis from high arterial tension and arteriosclerosis, but it is the very early and less prominent retinal lesions and their significance which so often escape attention. The discovery of almost indistinguishable small white dots in the macular region or in the neighborhood of the disk, the hazy or faintly milky colored areas, the beaded and irregular contour of some of the vessels, and scotoma, either with or without visible retinal alteration, should lead to further investigation, and will often be found to be associated with high arterial tension and urinary findings which point conclusively to the possible early development of pathologic changes which will take the life of the patient. It is therefore important to take the blood tension, examine the heart, and have made a thorough chemical and microscopic examination of the urine in all cases in which these suspicious retinal lesions are discovered. It is the combination of manifestations which make the picture which sometimes tells the fate of our patient, and if we are going to do the most for our patients we must recognize the retinal lesions and the associated manifestations at the earliest possible moment so that appropriate care may be instituted. Unless due care is observed the retinal lesions may be overlooked, for frequently they are discovered during the progress of a routine ophthalmoscopic examination in connection with the adjustment of glasses, and at a time when the patient considers himself perfectly well. As competent and careful ophthalmologists we are not doing our patients justice if we do not make a critical ophthalmoscopic examination in every refractive case, for it will often be found that something more than glasses is

required. In my experience the sphygmomanometer is almost as important as the ophthalmoscope in the ophthalmologist's office, and the use of the instrument in connection with careful chemical and microscopic examinations of the urine will throw much light on some of the lesions of the retina which otherwise might be overlooked or considered trivial and insignificant.

NASAL HYDRORRHEA

ITS RELATIONS TO LESIONS OF THE BRAIN AND VISUAL APPARATUS *

CASEY A. WOOD, M.D.
CHICAGO

The peculiar condition known as nasal hydrorrhea although it generally falls, first of all at least, within the purview of the rhinologist and ophthalmic surgeon, properly belongs to neither of these specialists. The tissue alterations that result in the serous discharge from the nose are almost always cranial and cerebral and, of course, should be the special property, not of the rhinologist but of the neurologist. It so happens, again, that this peculiar symptom is not infrequently associated with brain changes that affect the visual centers and give rise to eye symptoms. It is mainly with the latter that I propose to deal, although I present them as signs of the underlying, intracranial disease.

The first examples of the disease were reported as long ago as 1890,[1] by Dr. T. Melville Hardie and myself. Of these I now give the following abstract (Cases 1 and 2).

CASE 1.—Mrs. Mary S., aged 43, German, has one child, aged 14, healthy. Until nine years ago, when she came to America, she had always enjoyed good health. After living for two weeks in a basement, in February, 1881, she developed a cough which became asthmatic some time between March and July. She has had occasional attacks of asthma ever since, particularly in cold, damp weather. In July she received what her medical attendant told her was a sunstroke, which confined her to bed for some time. Pills (of quinin?) prescribed at that time caused a buzzing in the ears with deafness for several days, and during the severe headaches, usually vertical, from which she has suffered at intervals since that time, the deafness occasionally recurs.

In August or September, 1881, a watery discharge from the nose set in. The conjunctiva was reddened and lacrimation was profuse at the same time. The discharge lasted for three or four days, stopped for a month, came on for a few days, and again intermitted. Similar periods of discharge and its absence alternated continuously until about two and a half years ago, since which time the nasal flow has occurred daily, but as a rule only for three or four hours in the morning.

The patient reports that it begins just as soon as she rises in the morning, whether that be at 4:30 or 6:30. Excepting on one or two occasions, no discharge has been noticed at night. She cannot remember whether the discharge occurred on days on which she was confined to bed. She has never attempted to stop the discharge by lying down in the morning after the commencement of the flow. As a usual thing the fluid comes from both nostrils (sometimes from only one), and drop by drop. Shortly before stopping for the day the clear water, whitish and opalescent when in quantity, becomes thicker and viscid, and then resembles ordinary mucus. Sneezing and formication are somewhat frequent accompaniments of the outflow, but they are by no means constant, nor does the formication always precede the discharge, as one might expect; it quite as frequently follows it. The patient believes that the symptom has been aggravated by treatment. While the asthma is ordinarily troublesome only in cold and damp weather, she is not sure that the hydrorrhea is appreciably influenced by changes in the weather; nor has she noticed that it is worse on damp days. She thinks that it is as bad in July as it is in November, and varies in amount from time to time, without apparent reason.

In October, 1889, she found she "could not see to sew," and attended Dr. Franklin Coleman's eye clinic, where glasses were prescribed. She was then referred to me. Examination of her nose showed slight posterior hypertrophy of the right inferior turbinal and a dropsical condition of the middle turbinated bodies, right and left; ridge on the septum high up on the left side; no polypi; sense of smell unimpaired; no marked departure from normal sensibility of nasal mucous membrane as tested by the probe. Satisfactory posterior rhinoscopic view was not obtainable, tongue-depressor causing gagging.

The general health was not very good. A burning pain in the epigastrium after eating was not infrequent. There was a painful and hyperesthetic spot over the left eighth rib in front, which first became painful five years ago. There were no neuralgias. The patient was being treated in gynecologic clinic for laceration of the cervix. She had been treated during the past ten years by many regular practitioners and empirics, but without marked benefit. The removal by the snare of portions of the middle turbinated bodies, followed by the internal administration of zinc oxid (½ grain) and belladonna extract (¼ grain) markedly diminished the flow for a time. Treatment was begun on April 10, with good results until May 6, when a day-and-night discharge commenced. This lasted until May 9, the patient getting but little sleep in the interval. The nasal discharge was at that time accompanied by a flow from the eyes and a severe headache. On May 10 and 11 she had asthma; there was no discharge or headache. She was then almost free from unpleasant symptoms until June 3, since when she had an almost daily recurrence of the discharge until June 7, 1890, with asthma and headache from time to time. Patient's attendance had been very irregular since the beginning of June.

The fluid had a specific gravity of 1.006, contained chlorids, traces of mucin, a few cells from the olfactory region, and an occasional flat epithelial cell. It was feebly alkaline in reaction.

Dr. Hardie kindly associated me with him in this case and, at his request, I examined the patient's eyes with the following result:

M. S. has complained of weakness of sight, chiefly during the past eight months. Last November glasses were prescribed for her, which, however, she did not think enabled her to see any better. She suffers from bilateral epiphora, which is usually, though not always, worse in the morning. It then amounts to a continual flow from both eyes of a fluid resembling tears, and, generally speaking, is worse when the discharge from the nose is worse. During the daytime, also, when the nasal flow is lessened or stops altogether, there is very little lacrimation. The flow of tears has never produced excoriation of the lids. In November last vision, right eye, equaled 15/200, left eye, 15/40. She was then wearing right + 3 D., and left + 1.75 D., which on trial were found not to improve the visual acuity. Both adduction and abduction were weak, the latter 8°; the interni muscles could, after exercise, overcome a prism of 19°-23° only. At that time she complained of photophobia, and of dark spots in front of her eyes—in front of the right eye especially—and she thinks that for a time at least she was so blind that she could barely discern large objects. Then, for a while, her vision improved, but it has never since been normal, nor is it possible by correcting her refractive error (compound hyperopic astigmatism) greatly to improve the visual acuity. The conjunctivæ, both ocular and palpebral, are injected, but there is no purulent or mucopurulent secretion from the lids, and they do not adhere in the mornings. The last examination shows a marked improvement (in the right eye particularly), as vision, right eye, equals 20/40 and left eye, 30/40, both with correction. The puncta lacrimalia are patent and in normal position. There is no affection of either

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints. A copy of the latter will be sent by the author on receipt of a stamped addressed envelope.

1. Hardie and Wood: Two Cases of Nasal Hydrorrhea, with a Report on the Eye Symptoms, New York Med. Jour., Sept. 6, 1890, p. 264.

lacrimal sac, and no indication of obstruction of the nasal duct. The ocular excursions are of normal extent on both sides and in all directions. Pupils are both active to light and accommodation. Tension is normal in both eyes. The patient does not now complain of scotomata, only of weakness of vision and of inability to read or to do near work with comfort. These and the other ocular symptoms have not to any appreciable degree been relieved by atropin or by a full correction of the refractive error. A further examination of the case reveals the fact that the patient is not color-blind, and that she has no color scotomata. The fields of vision for red and white, taken by means of a McHardy perimeter with a 5 mm. square object, show a marked regular and symmetrical contraction.

The right disk is deeply and centrally excavated, and the blood-vessels come forward in a normal manner, but the whole papilla is slightly paler than it should be. On the nasal border of the nerve there is a narrow, yellowish-white band, forming in that situation the rim of the physiologic cup, and occupying about one-third of its circumference. A somewhat similar appearance is to be seen in the left disk. Here there is no general pallor, and the normal cupping is shallow. At its bottom, however, the stippling of the cribriform fascia is to be seen. A band, yellowish-white in appearance, longer than but quite as narrow as that visible in the right disk, occupies the lower-outer aspect of the left papilla. It does not extend, as in the former case, to the edge of the excavation toward the nerve center, nor does it reach in part of its course the outer rim of the disk.

Notwithstanding all treatment, the ocular symptoms are to date as pronounced as ever.

CASE 2.—Mrs. K. K., German, aged 42, two children, gave a history of profuse watery discharge from the nose which has lasted for ten years. Six months before the discharge began the patient suffered from "malaria" when living in a basement tenement. The flow was at the beginning not very profuse, but in a short time was troublesome throughout the day, and frequently all night as well. She was often wakened by it, and it was occasionally so profuse as to prevent sleep altogether. The intermissions were rare and of short duration. Patient asserted that the dropping had never ceased for twenty-four hours during the ten years, the amount of the discharge being about the same, summer and winter. The upper lip was swollen and excoriated. There was a watery discharge from eyes with occasional conjunctival injection. The fundus was normal; there was no optic-nerve atrophy and no contraction of visual fields. A troublesome and prominent symptom was sneezing, "forty or fifty times a day" being the usual thing. Unfortunately, the nasal excretion was not examined, the discharge ceasing before the patient followed instructions in the matter of collecting it. She did not know the amount of the daily discharge, as it was never measured, but the constant dropping interfered very much with her work. Examination of the nose showed polypi right and left, and polypoid thickening of both middle turbinated bodies. Treatment was begun February 25, and a few polypi removed.

March 8: Marked lessening of discharge reported. Remaining polypi removed.

March 12: Discharge very slight. No sneezing.

May 6: The same. Hypertrophy of right middle turbinal snared.

May 17: No discharge. No sneezing. Snaring of left middle turbinated bone. Patient reported absence of nasal symptoms on May 22, June 5, 12 and 19.

CASE 3.—Quite recently I examined the ophthalmic condition of a third patient illustrating this pathologic condition. The history elicited by Dr. Albert Sterne, of Indianapolis, Ind., shows that Mrs. McC., aged 36, has always enjoyed excellent health. She has been married seventeen years, and has two children, aged 16 and 12 years. After the second birth she had septic pelvic cellulitis with amaurosis, almost complete, for about three months, followed by good recovery, so far as the pelvic organs and eyes were concerned. The vision was nearly normal with correction of refraction. At the time of sepsis, twelve years ago, patient had an abscess, which was evacuated per vaginam.

Patient first came under Dr. McC.'s care for nasal and ear trouble about eight years ago, five years before he was married to her. There was, Dr. McC. reports, a catarrhal condition of the entire nasal field, extending along the eustachian tubes, and causing an ear trouble, with some deafness, which still persists. She never had any discharge from either ear. Except the pain about to be referred to, the patient has not been subject to headache at any time and menses have been in proper order. There have been no pregnancies since her boy's birth, thirteen years ago.

The present illness began three years ago, suddenly, the patient avers, with a watery discharge from the left naris. There was more or less constant dripping; when the head was bent forward the flow was more profuse. Altogether, it was estimated that 1 to 4 ounces of fluid escaped *per diem*. This discharge was always watery, and two examinations showed it to be cerebrospinal fluid. The discharge from the left naris continued without interruption for fifteen months, when it abruptly ceased, without known cause, just as it had begun. There had never been any injury to the head or nose at any time, or any discharge of pus or blood.

Sometime after the escape of cerebrospinal fluid ceased, the patient had a scleritis of the right eye, which was relieved by treatment. Later, she developed pain in the right half of the head. This is described as passing from the right eye toward the occiput mainly, sometimes more downward, into the cheek. It was not constant.

During the early part of October, 1911, while at dinner, the patient suddenly lost consciousness for about three minutes. Her head fell over on her arm, but she had no spasm of any sort. Dr. McC. was with her, hastened to her side and examined her eyes. He reported the pupils dilated and fixed. The patient was somewhat dazed after this attack, then recovered and was placed in bed after a hot bath. The left leg and arm tingled after seizure. No other such epileptiform seizure has since been noted.

A Wassermann was made and proved negative.

Present Condition.—The patient is of a fine robust physique. Speech is nasal and catarrhal; hearing considerably impaired; organs all fair to good, save that the liver is swollen; lungs free; kidneys, right excursive, but not floating.

Pelvic viscera show evidence of former inflammation. There is a hard exudative mass to right. Uterus is free. Ovaries are painful to pressure and not well defined.

In the central nervous system no focal signs are to be noted, nor are the reflexes affected. Static equilibrium and coordination are good; no sign of motor or sensory palsy. Cranial nerves are free. Sinuses illuminate clearly.

Therapy: Tentative. Cranial exploration or special puncture to be borne in mind.

Since Nov. 5, 1911, patient has improved pretty steadily without treatment of any sort, doing household tasks and a little reading. She reports that symptoms of importance have receded, i. e., there has been less headache, both as to degree and frequency; the sharper occasional pain over the left hemicranium has been very infrequent; the eyes have troubled less; there has been no loss of consciousness, or other signs referable to intracranial pressure. In fact, the patient feels better in every way. Secretions and excretions have been adequate. Further examination also reveals no new symptoms whatever. The liver is not now palpable.

In addition to the above report, Dr. Sterne, writing me on Nov. 5, 1911, says:

"Certain very serious questions present themselves. I recognize fully the seriousness of the outlook in every case of this kind, not only as regards vision, but as to epilepsy. As regards the latter condition, thus far we have had only epileptiform seizure, without convulsions. I have seen several cases of escape of cerebrospinal fluid from the nose, but all of these have been the result of injury. In this case there has been no injury. The history shows that the flow from the left naris began suddenly, continued for fifteen months and stopped with equal suddenness. Subsequent to the cessation of the flow, there developed scleritis in the right eye, the pains in the right half of the head, and recently the epileptiform seizure with subsequent sensory symptoms of the left arm and leg. At the

present time all of the symptoms, none of them, by the way, objective, point to a gross lesion of the right half of the brain, in spite of the fact that the escape of fluid was from the left naris.

"My diagnosis at this time is hydrocephalus, a chronic ependymitis, probably with occlusion of the right foramen of Monroe, but I may be in error about this. I should like to have some pretty definite knowledge of the condition of the sphenoid sinuses before definitely determining the cerebral lesion."

After several additional observations of this case, Dr. Sterne again wrote me on Jan. 19, 1912, as follows:

"From the date of my first examination on Nov. 5, 1911, I have felt inclined to regard the case as a right-sided, internal hydrocephalus, either with or without a cyst. The few indications, all subjective, which the patient reports, point to an involvement of the right side in spite of the fact that the hydrorrhea was from the left naris. The indications referred to were pain, sometimes radiating and sharp in the right half of the head, scleritis of the right eye and, after the epileptiform seizure had passed, tingling and numbness in the left arm and leg. As I wrote you some weeks ago, I have been and still am uncertain as to the modus of escape of the cerebrospinal fluid through the left naris. This could of course occur *via* any of the sinuses directly connected with the nose or through some abnormal channel caused by basal bone defect with lesion of the nasal mucosa. It is even possible that it may have made its way to the left naris, but I regard all of this as conjecture in the absence of definite symptoms and an apparent bone or sinus involvement at the present time.

"I saw Mrs. McC. again Dec. 27, 1911. At that time she showed an excellent physical condition and reported that she was feeling very much better *quoad* the pain in the right side of the head and the eyes. There had been no further seizure of an epileptiform type. In other words, nothing had developed which served to modify my opinion of the case. Subsequently I wrote to Dr. McC. counseling careful observation of the fundi and repeated examinations thereof, so that we would not be unexpectedly confronted with any situation pointing to brain lesion. Later Dr. McC. wrote me saying that he had examined the fundi and that he found considerably more blurring of the disk of the right eye with some atrophy following the lower nasal vessels for some distance from the entrance. In the left eye the disk was not so blurred, but there was a more decided patch of atrophy in the lower temporal quadrant. The fields were contracted in both eyes."

The husband, who is an expert ophthalmologist, wrote me Jan. 1, 1912, enclosing perimeter charts that showed a general contraction of the fields in both eyes for white—a limitation of their periphery that closely corresponded to the measurements made by my own assistant in September, 1911, when we first examined the case. On the former date he reported:

"In the right eye, or worse one, there is considerably more blurring of the disk than in the left, with the white atrophic nerve fibers following the lower nasal vessels for some distance from the entrance. In the left eye the disk is not so blurred, but in the lower temporal quadrant there is a more decided patch of atrophy than there is in any one place in the right disk."

To the foregoing reports I have to add that my colleague, Dr. Frank Brawley, made a careful examination of the nose and accessory sinuses on several occasions, and found nothing of pathologic importance or aught that threw any light on a possible aqueduct for the cerebrospinal fluid. The patient continued to complain of asthenopia on using her eyes, there was still some photophobia and a slight patch of scleral injection in the right eye. The pupil reflexes and the muscular balance were normal. With correction of a slight refractive error vision was practically full in each eye. The fundus changes were mostly confined to the papillæ, which, in both eyes, showed on the several occasions when I examined the patient blurred outlines and some swelling of the nerve-head proper. The retinal vessels were of normal size and outline, although in the congested optic papillæ there seemed to be a few new vessels. The disks were generally redder than normal and yet the physiologic cap was not filled up; indeed, as Dr. McC. remarked, the appearance was that of a mild postneuritic atrophy.

As shown by the accompanying charts of the fields of vision and by other signs, the patient's general condition, as well as the visual, cerebral and nasal symptoms, have on the whole slowly improved during the past six months. Whether this happy condition will continue or whether the surgical intervention spoken of will yet have to be undertaken remains to be seen.

The chief interest for us in the discussion of nasal hydrorrhea lies in its etiology and in the fact of the occasional presence of marked eye complications. The literature of the subject is by no means extensive, and the histories of cases in which a continuous discharge of water from the nose was a symptom will compel one to conclude that it may, like atrophy of the optic nerve, be produced by different conditions.

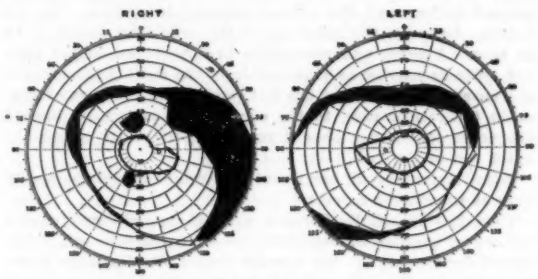

Fig. 1.—Case 3. Nasal hydrorrhea. Right, fields 5 mm., for red and white. Left, fields for white, red and green. Sept. 21, 1911.

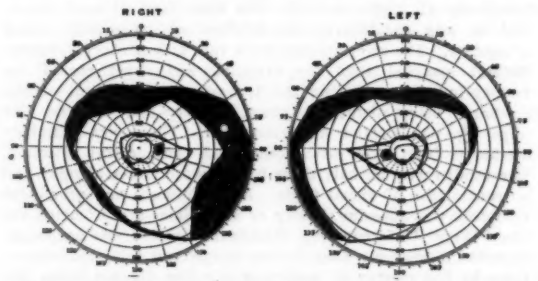

Fig. 2.—Case 3. Nasal hydrorrhea. Right, fields 5 mm. for white, red and green. Left, fields for white, red and green. Feb. 12, 1912.

Of the earlier cases one was evidently due to fracture of the base of the skull (Vieusse's[2] case); it is an occasional accompaniment of general anasarca (Rees[3]); of meningitis (Paget[4]); of trifacial paralysis (Althaus[5]); of hydrocephalus internus (Leber,[6] who thought there had been bone absorption from pressure with escape of the cerebrospinal fluid from the opening thus formed); while in some cases (Priestley Smith's[7] and Nettleship's[8]) the brain symptoms appear to have been very marked. On the other hand, in two cases reported by Bosworth,[9] to whose valuable paper on the subject I would refer the reader, this author believes the discharge to have been the direct result of a paresis of the sympa-

2. Vieusse: Gaz. hebd. de méd., 1879, No. 19, p. 298.
3. Rees: London Med. and Surg. Jour., 1834, iv, 823.
4. Paget: Tr. Clin. Soc. London, 1879, p. 43.
5. Althaus: Brit. Med. Jour., 1878, ii, 831.
6. Leber: Arch. Ophth. (Graefe's), xxix, 273.
7. Smith, Priestley: Ophth. Rev., London, ii, 4.
8. Nettleship: Ibid, p. 1.
9. Bosworth: Treatise on Diseases of the Nose and Throat, New York, 1889, i, 261.

thetic vasomotor nerves. Mules[10] reports three cases in support of his theory that "the dropping is due to over-distended lymph-vessels of the pituitary membrane which by their bursting cause fistulous openings into the nasal meati." Mules concludes that the coexistence of optic-nerve atrophy with an abnormal watery secretion from eye and nose is to some extent a coincidence. He explains the occurrence of the atrophy by suggesting that it may sometimes be due to the wasting character of the general disease, of which it and hydrorrhea happen to be symptoms. In some cases of hydrorrhea there is no atrophy, just as in other cases of atrophy there is no hydrorrhea.

A review of the three cases above detailed, as well as of others elsewhere reported, brings us to the following conclusions:

1. The rather rare condition known as nasal hydrorrhea is not a definite disease, but is merely a symptom of one or more pathologic states.

2. In the majority of cases optic atrophy, more or less pronounced, accompanies or follows the discharge from the nose.

3. The visual involvement is, like the chief nasal symptom, generally a part of an intracranial disease that underlies the affections of both nose and eyes.

4. The discharge that flows so copiously from the nose is cerebrospinal fluid, and it is just possible that when epiphora accompanies the hydrorrhea the lacrimal discharge may, in part at least, be of the same character.

5. The nasal hydrorrhea usually comes on without apparent reason, is generally intermittent as to amount and time, may disappear for a considerable interval or may cease entirely as quickly and mysteriously as it came.

6. If there be any organic disease of the nose it is, as a rule, merely a coincidence. Perhaps, however, some of the nasal lesions may be connected with the bony defects or minute fistulas through which the intracranial fluid finds its way into the upper nasal passages.

7. The underlying cerebral disease is frequently some form of hydrocephalus. The intracranial tension due to this disease finds relief by seepage of fluids through one or more basal openings (pressure-passages, congenital, natural or acquired) into the nasal meati or neighboring sinuses.

8. The course of the optic atrophy depends on the character of the brain lesion, and especially on the extent to which the visual centers are involved by the cerebral disease.

9. In every case of nasal hydrorrhea treatment of the brain alterations should first of all be considered; and, in this connection, lumbar puncture, or some decompression operation ought to be borne in mind.

7 West Madison Street.

ABSTRACT OF DISCUSSION

DR. OSCAR WILKINSON, Washington, D. C.: As one who does nose work as well as eye work I have seen a good many cases of hydrorrhea, but I regret not to agree with Dr. Wood in some of his conclusions. In his second conclusion he says, "In the majority of cases optic atrophy, more or less pronounced, accompanies or follows the discharge from the nose." This is in hydrorrhea cases. Out of at least twenty hydrorrhea cases which I have seen only one or two developed atrophy. I have known at least two or three persons who were treated for hydrorrhea, and as far as I can determine, the symptoms were very much as in Dr. Wood's cases. In his fourth conclusion Dr. Wood says, "The discharge that flows so copiously from the nose is cerebrospinal fluid, and it is just possible that when epiphora accompanies the hydrorrhea the lacrimal discharge may in part, at least, be of the same character." From an anatomical standpoint we can hardly conceive how the lacrimal fluid can be cerebrospinal fluid or a mixture with cerebrospinal fluid. The very nature of the cellular tissue of the orbit would give us an edematous condition if we had a leakage into the orbital tissue. Instead of having hypersecretion from the eye or a lacrimose condition, we would get an edematous condition if we had cerebrospinal fluid. It is my opinion of these cases that there are three elements necessary: (1) a neurotic subject; (2) an auto-intoxication of some kind that has aggravated these nervous filaments, and (3) a latent sinusitis which has very likely destroyed the cerebral plate of the sinus sufficiently to allow the gradual leaking into the sinus cavity. This cerebrospinal fluid is not thrown out all at once from the cerebral cavity, but is an overflow from the sinus cavity which has accumulated during the night.

DR. CASEY A. WOOD, Chicago: I agree with Dr. Wilkinson in a measure and I think his objection is well taken. What ought to have been more definitely stated is that when the lesion involves both the nose and the eyes and the discharge contains cerebrospinal fluid, the underlying disease is a hydrocephalus, which in its turn is, of course, only one form of a pathologic process of variable character going on within the cranium. In such cases it will be found that the optic nerve is more or less involved sooner or later, and restrictions of the field, generally positive scotomas, will be found in the great majority of cases.

10. Mules: Tr. Ophth. Cong., Heidelberg, 1888.

A CLINICAL COMMUNICATION ON CERTAIN VISUAL-FIELD DEFECTS IN HYPOPHYSIS DISEASE, WITH SPECIAL REFERENCE TO SCOTOMAS *

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AND
T. B. HOLLOWAY, M.D.
PHILADELPHIA

For many years the symptoms of affections of the hypophysis have attracted conspicuous attention, and naturally the visual-field defects of disease of this gland have been carefully studied.

No one more thoroughly than Harvey Cushing has studied all phases of pituitary body disease from the physiologic, experimental and practical surgical aspects, and during these studies he has accumulated and charted a series of visual fields which are of the highest importance and greatest interest.

We desire in this brief communication to make special reference to certain localized visual defects, to wit, scotomas, central, paracentral and peripheral, which have been noted under these circumstances, and to which, it would seem from an examination of the literature, an insufficient amount of attention has been paid, although they have by no means been neglected and have often been charted. They are the subject of special reference in Bartels' paper.

The close anatomic relationship of the optic chiasm to the hypophysis naturally brings about as a frequent symptom of tumor or disease of the latter body the various visual defects which disease of the former structure can produce, and one not infrequently sees statements, such, for example, as Hochwart has made, that in the present state of our knowledge the diagnosis of tumors of the hypophysis is not very difficult. Cer-

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the authors' reprints.

tainly when the symptoms of pituitary body disease, both general and trophic, are well developed, and when the visual field defects are pronounced, especially the so-called typical bitemporal hemianopsia, accurate diagnosis is not difficult and is frequently often promptly confirmed by *x*-ray findings. It is a mistake, however, to fix our attention too definitely on hemianopsia of the bitemporal variety as a typical hypophysis disease field,[6] especially as lateral homonymous and nasal hemianopsia may occur. Moreover, the visual disturbances in pituitary body tumors are for the most part dependent on compression of the optic chiasm, optic tracts, or the optic nerves by the growth, and as these neoplasms may be vascular or cystic, variations in the visual field defects are constantly found, particularly if, as A. de Kleijn[4] maintains, perimetric examination is a daily routine. Thus he insists that in one patient a classical hemianopsia may be present at one time, but if daily

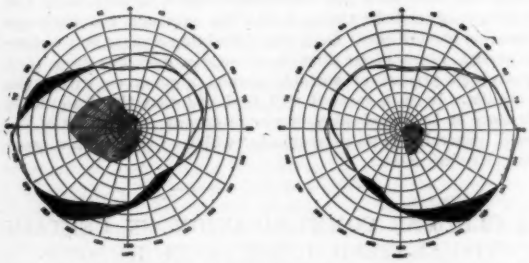

Fig. 1.—Marlow's case of acromegaly with large temporal scotomas, somewhat resembling bitemporal defects described by Uhthoff as suggestive of pituitary bone tumors.

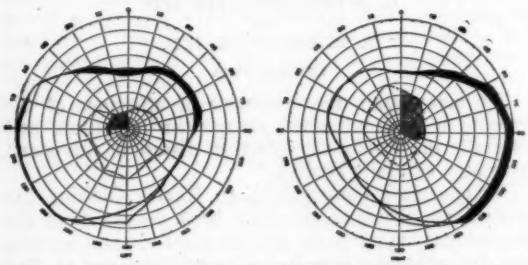

Fig. 2.—Doyne's case of acromegaly; scotoma up and out from fixing point; later bitemporal hemianopsia.

examinations are made, it will often be found that it has given place to an ordinary concentric contraction. Again, as in certain other diseases, the visual-field defect of tumor of the hypophysis may assume an insular shape, as it did in one of de Kleijn's patients; and this insular shape is subject to variations. The islands vary, not only in their number, but in their relation to the part of the visual field which they occupy.

It is not the purpose of the present brief communication to refer to the variations of the visual field in hypophysis disease, but only to say a few words in regard to some of the scotomas which may be found under these circumstances.

That central scotomas (paracentral in the sense that they proceed to the outer side of the fixing point and close to it) may antedate the development of bitemporal hemianopsia from chiasm disease, has long been known.

Just because the alterations in the visual field under these conditions are subject, as already pointed out, to marked variations, it is difficult to arrange a classification of these scotomas. The following list would seem to be a permissible attempt in this respect:

1. These scotomas may be, like those already referred to when discussing chiasmal amblyopia (and in many of the instances of this affection doubtless they were due to hypophysis growth), small and paracentral. Subsequently, with increase in the size of the growth and of the pressure symptoms, they may expand into complete hemianopsia. There may be, as, for example, was the case in Marlow's[11] patient with hypophysis disease, in one eye a scotoma just outside of the fixing point and a larger one, more produced to the temporal side but including the fixing point, in the opposite field (Fig. 1), the peripheral fields at the same time being comparatively full. Or there may be, as in one of our own cases, a small paracentral scotoma of one field, with a contraction of the color field of the opposite eye, the contraction being relatively greater on the temporal side (compare Figs. 6 and 7).

2. An absolute or relative defect may be detected up and out, forming a quadrant in the manner shown in the accompanying diagram, one of the best examples being the field charted by Mr. R. W. Doyne[12] of a patient suffering from optic-nerve atrophy with acromegaly.

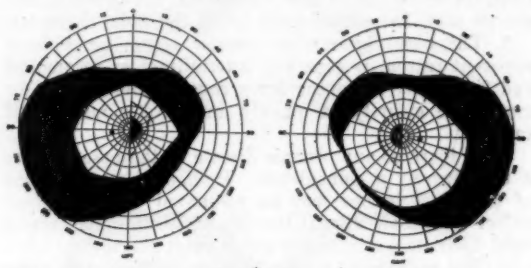

Fig. 3.—Binasal scotomas lasting two weeks; bitemporal color defects. Zentmayer's case of acromegaly.

Such scotomas may be bilateral or symmetrical, or nearly so, the larger scotoma, however, as in Doyne's case, usually being seen in the field of the eye with the poorer vision, or the scotoma may be unilateral (Fig. 2). A somewhat similar instance, the left scotoma being directly above the fixing point and the right one up and out in the usual position, has occurred in our own experience (Compare Fig. 5). Again, the scotoma may exist in one field in the position previously named and be associated with a small central scotoma in the opposite field, as in one of our own patients during the period of convalescence of pituitary body disease (compare Fig. 10).

3. Just as the visual fields in vascular basal disease, particularly if the hypophysis is involved, may vary from day to day, certainly from week to week, owing to the varying degrees of pressure which the neoplasm or struma produces, so it is possible that these scotomas vary in size and in position, and that they may be present for a period of time and then disappear. For example, in Zentmayer's[13] well-reported case hemianopic scotomas persisted for two weeks, and, moreover, on the nasal side, and were associated with contracted form fields and with bitemporal hemianopic color defects (Fig. 3). Curiously enough, it may happen that after more or less

6. Bartels (see Note 1) points out that so-called typical hemianopsia occurs in only about one-third of the cases of tumors of the hypophyseal region where diagnosis has been confirmed by autopsy.

11. New York Med. Jour., 1910, xci, 794.
12. Tr. Ophth. Soc. U. Kingdom, 1895, p. 133.
13. Ann. Ophth., 1910, xix, 719.

typical visual-field defects have disappeared as the result of treatment, a recrudescence of visual disturbances may arise, dependent on the presence of large central scotomas. This was the case in a patient examined by Lauber.[14] At first the left eye was blind and the right eye had temporal hemianopsia. After mercurialization, the diagnosis having been syphilis of the hypophysis, the right field was entirely restored, as was the nasal half of the left field. With the ophthalmoscope atrophy of the optic nerve was evident. Some months later vision again fell, then on account of the presence of the scotoma before referred to. Another variation is contracted from field, color hemianopsia and central scotoma, as, for example, in Kocher's[15] patient, diagnosis having been settled by operation. Again, as in Bartels'[16] case there may be contraction of the form and color fields and central relative scotomas.

4. Kund Pontoppidan[17] has observed with normal form-fields large bitemporal hemianopic scotomas, absolute in the right field and relative in the left, due to a tumor situated within the circle of Willis, extending from the anterior border of the pons to the chiasm. The infundibulum emerged from the most prominent portion of the growth (Fig. 4). Uhthoff[18] has recently demonstrated and insisted that such large paracentral absolute scotomas in the outer halves of the visual field are a conspicuous and, according to his observations, a frequently observed phenomenon in connection with hypophysis tumors. These scotomas are similar to the one depicted in the left field of Figure 1.

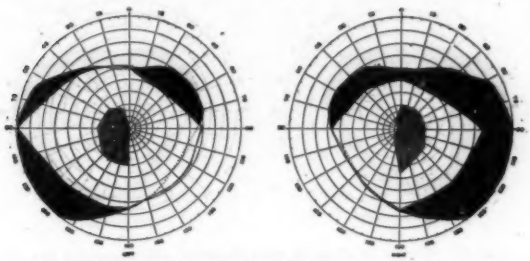

Fig. 4.—Visual fields of Pontoppidan's patient with large bitemporal hemianopic scotomas.

5. Occasionally a scotoma has been noted in the temporal field at some distance from the fixation point which is manifest before, and, in point of fact, at some considerable time before, the entire field is obliterated. This we have observed in one undoubted case of pituitary body disease and in another case supposed at the time to be of like nature, but in which subsequently an autopsy demonstrated that the pituitary body itself was uninvolved in a neoplasm, but probably that the pressure was on the tract posterior to the chiasm. In the field of the first of these patients the scotoma existed as an oblong area lying below the horizontal meridian which it touched at its upper end, and therefore it was in the lower and outer quadrant of the field. In the same field there was a paracentral scotoma of the type already described (Compare Fig. 8). A very similar visual-field defect which occurred in the second case (the pressure in this instance having been on the tract, so that ultimately a homonymous hemianopsia developed), occupied an exactly similar place, although it was not so great in extent, and, moreover, was in a field which was not subsequently obliterated. Nothing in the eye-ground accounted for the presence of these scotomas, and their explanation is not very clear. They are mentioned here not because they seem to have any very great significance—at least the observations are too limited in number to place any satisfactory interpretation on this visual-field defect—but rather because they belong to what may be described as some of the curiosities of the visual-field phenomena in basal disease of the brain. It is not uncommon to find islands of preserved vision in the dark fields of pituitary body affections which have a similar appearance. These islands have somewhat the same situation and extent which these scotomas present. In other words, in the one instance an area is preserved which in the other is obliterated.

6. We would like to call attention to the fact that in some of these cases for a considerable period of time prior to the development of a central scotoma, even when most searching examination fails to reveal it, the patient is conscious of blurred vision; indeed, the blurred vision itself may be the symptom which causes the patient to seek advice. This symptom was so conspicuous in one of our patients and so notable in another that perhaps it may be described as an antecedent amblyopia. The patient is conscious of a blur which is unexplained by any opthalmoscopic lesions and which cannot be demonstrated in the sense that a test-object on the perimeter can outline an area of defective vision. To this point we shall return later.

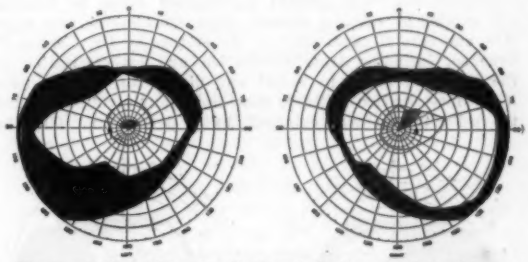

Fig. 5.—Authors' Case 1; pituitary body tumor. Concentric contraction; scotoma up and out from fixing point in right field and above fixing point in left.

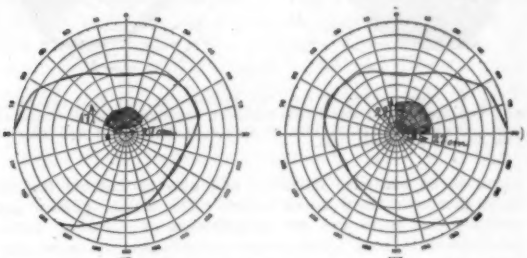

Fig. 6.—Case 1; same scotomas as in Figure 5, charted on a black screen at one meter's distance from patient's eye with a 3 mm. white object.

CASE REPORTS

The following case histories illustrate some of the scotomas to which we have made reference:

CASE 1.—*History.*—A man, aged 32, came under observation Oct. 26, 1911. The patient's father and mother are living and well. The father is deaf as the result of a chronic catarrhal otitis media. The oldest sister in the family is slightly deaf and the youngest sister quite deaf from some

14. Klin. Monatsbl. f. Augenh., 1910, xlviii, 20
15. Deutsch. Ztschr. f. Chir., 1909, c, 13.
16. Ztschr. f. Augenh., 1906, xvi, 407.
17. Hospitalstid., December, 1897, xl, 1137.
18. Klin. Monatsbl. f. Augenh., 1911, xlix, 393.

trouble believed to be situated in the auditory nerve. One other sister is perfectly healthy. A brother, when 16 years of age, developed optic nerve atrophy with scotomas, but under proper treatment these have largely disappeared, and although there are still scotomas in the periphery of the visual fields, fixation is perfectly clear in both eyes and vision good. The patient's mother had one brother who is said to see badly, "due to amaurosis," probably therefore an optic nerve atrophy. There is no history of tuberculosis, syphilis, neoplasm, cardiac or renal disease in the family. One maternal uncle is a man of great size and weighs upward of 300 pounds. The patient weighed 15 pounds at birth. He was, until his eyesight became defective, in active business. He has been extremely irregular in regard to his meals, has always indulged in much pastry and sweetmeats, and exhibits an astonishing tolerance to carbohydrates. Very little tobacco, tea or alcohol has been used. Specific infection is denied, and the Wassermann test is negative. At 17 years of age he had inflammatory rheumatism, and since then has suffered from several mild attacks. About two years prior to this report the patient's average weight was 265 pounds, and for the past half year about 290 pounds.

Examination.—The general examination failed to discover any cardiac or vascular disease, urine examination was negative, and careful exploration of the sinuses by Dr. Charles P. Grayson, including transillumination and catheterization of the sphenoid, failed to reveal any disease in these regions. *X*-ray investigation failed to show any sinus involvement, but the sella turcica was enlarged, badly defined and filled in.

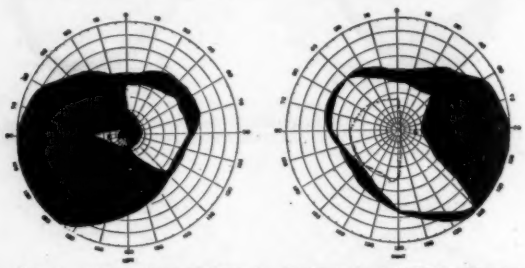

Fig. 9.—Later stage of Case 2. Scotoma in left field enlarging and encroaching on nasal side; almost complete loss of temporal field; complete temporal loss of colors in right field and partial temporal loss of form field.

There is no excessive hairiness and also no notable loss of hair, although there is no beard. The sexual powers are normal, and there are no disturbances of taste or smell. Intellection is good. The tendon reflexes appear to be normal. The patient is a man of large frame, fat, but with firm flesh and with rather coarse skin. His hands and feet are large, but a spade-like character of the hands can hardly be said to be present.

Ocular Examination: When first examined the vision of the right eye was 4/15, of the left eye 4/45. This vision, in spite of all treatment, has steadily declined until at the present time it is 4/100 in each eye. There is no swelling of either disk, but some deep pallor, more marked in the right eye, on the outer side of the disk. The veins are tortuous, the arteries about normal in size. On one occasion a small hemorrhage just below the margin of the disk was observed.

The visual fields, taken on numerous occasions, are illustrated in the accompanying diagrams, namely, a moderate concentric contraction of the right field, with a somewhat wedge-shaped scotoma for red and white up and out; left eye, a greater concentric contraction, more pronounced down and out and up and out than elsewhere, with an oval scotoma capping the fixing point. There is moderate contraction of the red field; green not recognized (Figs. 5 and 6).

CASE 2.[19]—*History.*—An unmarried woman, aged 39, consulted one of us (Dr. de Schweinitz) on April 9, 1910, for the relief of blurred vision, particularly of the left eye, which had existed since the previous November, and which continued in spite of various changes in glasses. There was no family history of neoplasm, rheumatism, syphilis, or of ocular disease. The patient was born in this country, was a good student at school, and after graduation worked hard as a teacher. Menstruation was established before the twelfth year of life, and continued with fair regularity until the patient's twenty-first year, at which time the periods ceased and were not again reestablished. The patient has had measles, pertussis and chicken-pox twice, has often suffered from laryngitis, which has always responded to antirheumatic treatment.

Examination.—There is not the faintest evidence that the patient was ever affected by any form of venereal disease. She is well formed but not excessively fat, nor are there any signs of dystrophy.

Ocular Examination: At the first ocular examination, with proper correcting glasses, the vision of the right eye was 6/7.5 and of the left eye 6/9; no diplopia. The blur in vision, however, which the patient had reported at her visit and for which she sought relief, continued. Ophthalmoscopic examination failed to reveal the slightest change in the fundus. Three weeks after this date the vision of the right eye was reduced to 6/15, and of the left eye to 30 cm./60. The right pupil was 4.5 mm. and the left 5 mm. in width, and the left eye slightly divergent. The reflexes of the right pupil were preserved, but neither direct nor indirect light reflex of the left pupil was present. During this period of three weeks the patient suffered with intense headache and nausea.

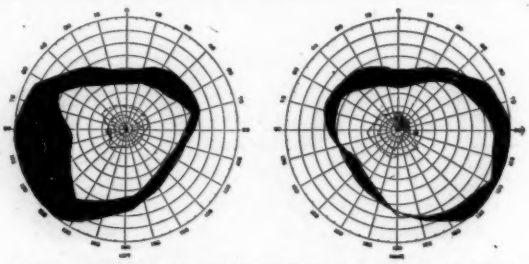

Fig. 10.—Case 2 in stage of convalescence. Hemianopsia has disappeared; concentric contraction remains; scotoma up and out for colors in right field and central in left field.

There were now moderate contraction of the right visual field, marked concentric contraction of the color field, with greater loss on the temporal side, concentric contraction of the left field, a central or hemianopic scotoma, and a large oval scotoma in the peripheral field (See Fig. 8). After admission to the University Hospital, thorough studies were made from all standpoints. These failed to reveal any disease of the general system except that the *x*-ray examination showed great enlargement of the sella turcica on account of a growth within it. The important symptoms, in addition to those exhibited by the eye, were complete cessation of menstruation at the age of 21 until the present time, exaggeration of the tendon-reflexes of the upper limbs and of the patellar tendon, and diminution in the sense of smell. Vision rapidly failed, left oculomotor palsy developed, and the changes in the field of vision shown in the diagrams occurred, only those being reproduced which indicate the presence of scotoma (Figs. 8 and 9.)

Bitemporal hemianopsia, first for colors and later for form, developed, followed by a gradual disappearance of the entire visual field, with total blindness of the right eye lasting twelve days, and of the left eye lasting six weeks. After months of treatment there was complete restoration of vision as the result of the administration of large doses of thyroid extract, associated with inunctions of unguentum hydrargyrum. During the period of convalescence, for a time there was a scotoma up and out in the right eye and central in the left. Ultimately these scotomas disappeared, except a small oval scotoma in the far peripheral field, the remnant of the original large scotoma in the same area which had been

19. This case is also included in a series reported to the Pa. State Med. Soc., September, 1911

found at the first examination and to which special reference has been made (Figs. 10 and 11).

REMARKS

We have already made reference to what Patrick calls the relative frequency of scotomas in pituitary body disease. In Uhthoff's[5] list of the ocular symptoms of 148 cases of hypophysis and infundibular tumors without acromegaly, scotomas are reported only three times, although in the text there are at least four references to them. Bartels[1] among a total of twenty-two cases of hypophysis tumor, the diagnosis having been confirmed by autopsy, records 13 per cent. of central scotomas, or practically three cases. Concerning central scotomas in 180 cases of acromegaly, Uhthoff simply remarks that they have been observed by Bartels, Gubler and others, but that these occurrences are uncommon phenomena. Now it goes without saying that although only three scotomas are mentioned in the long list of non-acromegalic cases which Uhthoff records, and that he describes them as relatively infrequent in the acromegalic cases, this gives no idea of their actual frequency. The search for them may have been insufficient, or the fields may have been charted at a time when they were not present. We know that they may antedate the gross visual-field defects by a considerable period of time. It is not a little remarkable that de Kleijn, who has so

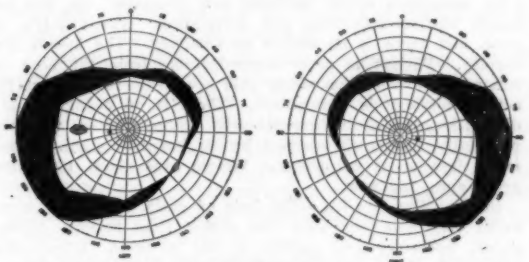

Fig. 11.—Case 2 in stage approaching recovery; all trace of former scotomas gone except remnant of scotoma in left temporal field. Good color fields (not charted). Vision: right, 6/6; left, 6/9.

carefully investigated the variations of the visual fields in pituitary body disease, has failed to note scotomas, nor do they appear in the large series of charts in the Cushing collection. This Dr. Cushing explains exactly as we have explained their absence of record in much of the literature on the subject, by assuming that the visual fields were taken either at a time when the scotoma was not present, because it had expanded into a grosser visual-field defect, or because an exact search on account of patient's condition could not be made for it.

While it is not likely that the presence of scotomas of this character would in many instances be mistaken for those caused by toxic agents, the ordinary so-called intoxication-amblyopia scotomas, this is not beyond the range of possibility. For example, Jonathan Hutchinson[20] records the case history of a patient who smoked one-half ounce of shag daily, and who had central scotomas for read and green. Death occurred, and at the autopsy a soft glioma, involving the apex of the right temporosphenoidal lobe and reaching across the middle line in the interpeduncular space, was found. This case is mentioned although it is not descriptive of hypophysis disease, because it illustrates the fact that an intracranial lesion interpreting itself at first in central scotomas occurring in a man addicted to excessive smoking received a wrong interpretation. This, therefore, might also occur in hypophysis disease. Indeed, Pontoppidan[17] at first believed that his patient was suffering from retrobulbar neuritis due to excessive use of tobacco.

It would be interesting, taking Wilbrand and Saenger's[21] plan of the distribution of the fibers in the optic chiasm as a guide, to attempt to place the probable situation of the lesions which these scotomas interpret, but in large measure such an attempt would be a piece of guess-work, except in a few instances. As Bartels points out, it may happen that although the visual disturbances may depend on the presence of a central scotoma, no clear explanation for its presence is demonstrable at autopsy.

There seems very little doubt that some of the visual-field defects caused by basal disease depend on vascular constriction. Thus, as early as 1852, Türck[22] reported a case of carcinoma situated posterior to the chiasm which pushed this structure upward and anteriorly, and both optic nerves were found to be transversely notched by the pressure of anterior cerebral arteries close to their exit from the chiasm. The left nerve was so badly constricted that only a thin strand remained, while the inner third of the right nerve was uninjured.

In 1893 Sachs[23] analyzed forty-eight autopsies on patients with hypophyseal tumor, and twice found constriction of the optic nerves. In his case the tumor grew in front of the chiasm, and both optic nerves were deeply grooved by the anterior cerebral arteries. Since then a number of analogous instances have been placed on record by Erdheim,[24] Uhthoff,[18] Bartels[1] and Strada,[25] the first named author referring to seven cases. In Uhthoff's and Bartels' patients and in two of Erdheim's the tract was constricted. The autopsy on Bartels' patient revealed that the growth had developed behind the chiasm, pushing this structure forward so that the optic tract was deeply constricted by the anterior cerebral artery. Bartels in his excellent contribution to this subject states that this vascular constriction, owing to its position, is readily overlooked. Cushing in his fine studies of this region has prepared a number of specimens which exactly demonstrate these conditions.

We believe that this condition must have an important bearing on the visual disturbances and visual-field defects in cases of hypophyseal tumor, and is undoubtedly an important factor in many cases associated with marked impairment of visual acuity, and may be a determining factor in the blindness which sometimes almost abruptly affects these patients.

1795 Walnut Street.

20. Roy. Lond. Ophth. Hosp. Rep., 1888-89, xii.

21. Die Neurologie des Auges, 1904, iii, 110.
22. Ztschr. d. k. k. Gesellsch. der Aerzte zu Wien, 1852, viii, 299.
23. Ztschr. f. Augenh., 1905, xiii, 378.
24. Cited by Bartels (see Note 1).
25. Strada: Arch. f. Path. Anat. (Virchow's), 1911, ccili, 1.

* Owing to lack of space this article has been abbreviated by condensation of the abstracts of cases. The complete article appears in the Transactions of the Section and in the author's reprints. A copy of the latter will be sent by the author on receipt of a stamped addressed envelope.

DISEASE OF THE OPTIC NERVE IN MYXEDEMA

ITS RELATIONSHIP TO THE THYROID GLAND AND TO THE HYPOPHYSIS *

GEORGE S. DERBY, M.D.
BOSTON

The title of this paper suggests a very limited field in ophthalmology, and probably one that is of immediate

interest to only a few in our Section. Unless some particular clinical experience, or one of the infrequent references in the literature has directed our attention to an undoubted connection between the thyroid gland and the hypophysis cerebri, their relationship may never have come to our notice. On this ground, and also in the hope of making some small contribution to the knowledge of the subject, the following two rare cases are reported:

CASE 1.—Myxedema with optic atrophy and bitemporal hemianopsia dependent on a probable enlargement of the hypophysis.

Patient.—Mrs. A. B., 56 years old, was referred to me Oct. 13, 1910, by Dr. W. L. Richardson and Dr. W. H. Smith. Dr. Smith, from whom I obtained her history, saw her first Aug. 29, 1910. Family history and previous history were negative, except that some years before she had suffered from arsenical poisoning. She complained of nothing except stiffness in her right knee and trifling swelling of her feet. She sought medical advice because her family had noticed a considerable degree of stillness in her mental actions and in her general condition. The members of her family said that she forgot easily, had a tendency to marked drowsiness, and had changed much in her general appearance. Patient's appearance and actions myxedematous. Lungs negative. Heart-sounds faint; soft systolic murmur at apex; no cardiac enlargement. Very slight amount of hair in the axilla; the hair on the scalp thin. Very little perspiration. Abdomen negative. Knee-jerks not obtained; some stiffness of the right knee with limitations of motion. Trifling edema of the feet. Moderate psoriasis. Nails brittle. Urine: twenty-four hour amount 54 ounces; normal acid; specific gravity 1.012; slightest possible trace of albumin; urea 13.7 gm., no bile and no sugar; sediment negative.

Ophthalmic Examination.—Mrs. B. complained of difficulty especially in reading. Her sight had always been good until recently, when she had noticed a general haziness. Through the kindness of Dr. O. F. Wadsworth and Dr. C. H. Williams, I am enabled to record her ocular condition on two previous occasions.

In 1902, Dr. Wadsworth found:

V. R. — .75 sph. = 6/4.
V. L. — 1.0 sph. = 6/4.

Muscles were normal; fundi normal.

In August, 1909, Dr. C. H. Williams made the following

V. R. — 1.0 sph. ⊃ — .50 cyl. axis 180 = 6/10.
V. L. — 1.0 sph. = 6/12.

The ophthalmoscopic examination showed "retinal arteries rather small, especially in the right eye; disks slightly grayer than normal." "Pupils reacted feebly to light."

At the time of her visit to me, vision was as follows:

V. R. = 6/60 not improved.
V. L. — 1.0 sph. = 6/15.

The pupils were equal and reacted sluggishly to light. The tension was normal to the finger The ophthalmoscope showed marked atrophy of the right nerve-head, moderate pallor of the left nerve-head, with possible slight diminution in the size of the vessels.

The lower temporal quadrant of the right field was markedly contracted, while the left field showed a slight contraction on the temporal side. A satisfactory color field could not be taken on account of the mental condition of the patient. In fact, it was difficult to take the field for form, as she tired so easily.

Jan. 17, 1912, she presented herself again for examination.

V. R. = 2/60, not improved.
V. L. — 2.0 sph. = 6/15 —.

The field showed a well-defined bitemporal hemianopsia extending beyond the fixation point in the right eye, and reaching that point in the left.

The ophthalmoscopic examination showed a marked atrophy of the right nerve-head with vessels apparently of normal size, and little, if any, sign of a previous inflammation. The left nerve-head was somewhat atrophic, but of much better color than the right. It was somewhat pale on the temporal side. The outlines were clear, and the vessels seemed to be nearly of normal size. A few small rounded flecks of hemorrhage were seen in the surrounding retina.

Mrs. B. was put on thyroid extract with very marked improvement. She grew a complete set of perfect nails, and her mental condition improved considerably.

CASE 2.—Myxedema with concentric contraction of the fields, low-grade optic neuritis, chorioretinitis.

Patient.—F. M. S., a man, aged 49, married, hotel-keeper, living in Maine, was referred by Dr. F. T. Lord, to whom I am indebted for the history and general examination. Family history is negative; no consanguineous marriages. Father and mother, nine brothers and sisters are living and well. Patient had children's diseases; was twice injured by being kicked in the face by a horse, fifteen and thirteen years ago. He had lumbago twelve years ago; no rheumatism. He denies venereal disease and any opportunity for infection. He has one daughter, aged 24, healthy. His wife had one still-born child, but no miscarriages. He uses no alcohol or tobacco; has been a hard worker.

Present Illness.—Ten years ago he began gradually to lose his hair, that of the scalp, beard and mustache becoming very thin, while the axillary and pubic hair, the eyebrows and eyelashes entirely disappeared. For three or four years the ankles and hands had been slightly swollen. For the last three years, the patient has suffered a progressive loss of sight which affected both eyes, the left, however, more than the right. At times, he has a feeling of pressure in his eyes, occasional slight headache and dizziness. He has no cough, but some dyspnea and palpitation. The appetite is good, and there is no nausea or vomiting. The bowels are regular. Patient is never uncomfortable from the heat in summer, but feels the winter cold severely. He is mentally active; memory is unimpaired. There is no change in his disposition, which is exceptionally even. He is vigorous physically, but much troubled by his impaired sight. There is no loss of sexual power. Weight was about 180 three years ago; 160 now.

General Examination.—The hair of scalp, beard and mustache very thin and soft, fine rather than coarse. Axillæ, pubes, eyebrows and eyelids devoid of hair. Upper lids abnormally thick with obliteration of normal folds and depressions, but no obvious edema. Hands large, and the skin over the dorsal surface slightly thickened, rough and dry, but without edema. Tips of the fingers slightly clubbed. Anteroposterior and lateral convexity of the nails. Nails somewhat ridged and brittle. Feet of normal size. Marked edema of the legs, pitting regularly on pressure. No varicose veins. (It may be remarked that the patient has always had rather large hands.) Blood-pressure 150. Urine normal color; specific gravity, 1.012; albumin and sugar present; sediment negative. Blood: hemoglobin 100 per cent.; no leukocytosis; differential count negative.

Stereoscopic radiographs of skull show nothing abnormal. Mr. S.'s vision began to fail three years ago, beginning in the right eye.

Ophthalmic Examination.—On May 10, 1910, the patient was examined by Dr. C. H. Williams, to whom I am greatly indebted for his record at that time.

V. R. — .50 cyl. axis 90 = 6/30.
V. L. — .50 cyl. axis 90 = 6/12.

"The ophthalmoscopic examination showed smoky-looking disks, and small retinal arteries. There were no fundus lesions." The field was not taken.

At the time of the patient's visit to me, he complained of failing sight, which had been continuous. He said that he saw as well at dusk as in daylight.

V. R. — 1.0 sph. = 6/60.
V. L. = 2/60 excentric not improved.

Pupils equal, but react sluggishly to light.

Ophthalmoscopic examination showed: Right: Optic disk is pale, and of a grayish color on the borders. Slightly hyperemic in the center. Outlines are blurred; the vessels

decidedly small. The arteries are slightly small, and show white lines along them. The veins apparently slightly narrow also. In the macula region is a moderate-sized whitish area of atrophy liberally sprinkled with dark pigment. In the periphery of the fundus are numerous small masses of pigment of bone-corpuscle shape. The retina throughout is of a granular appearance.

Left: The optic nerve-head is paler than in the right eye. Its outlines are slightly indistinct; no swelling; the vessels are decidedly smaller than normal. The arteries show white lines. A short distance downward and out from the disk are three small rounded areas of chorioidal atrophy sprinkled with pigment. Below these is a similar area, but of larger size. In the periphery of the retina are many small masses of pigment of bone-corpuscle shape. In this eye, also, the retina is sprinkled with minute dark spots, and presents a decidedly granular appearance.

The field of vision in the right eye, taken with a 10-mm. object, shows a concentric contraction, so that only an irregular area of about 22 degrees in its greatest diameter remains centrally. This area approaches the fixation point below. In this area, the patient distinguishes colors.

In the left eye, the field shows a small remaining area, not much over 5 degrees in diameter, of uncertain outline and situated, as far as can be determined, slightly to the nasal side of the center. In this area, white and red can be distinguished.

Before discussing these two cases, it may be well to consider others of a similar nature which have been reported. There are few of them, and unfortunately several are incompletely described.

A search through the literature has disclosed cases of a somewhat similar nature reported by Schmidt-Rimpler, Sanesi, Wagner, Burchard, Bolte, Pollack, Meyer, Gourfein-Welt, Moore, Berliner, Souroff and Hennicke. For convenience they are abstracted at the end of this article.

If the condition of the optic nerve, as evidenced by the ophthalmoscopic examination, be analyzed in these fourteen cases, the most marked change is found to be a low-grade optic neuritis.

In Bolte's case, for instance, the outlines of the nerve-head were irregular and blurred; the veins were rather swollen and tortuous; the vessels projected forward on the disk. Wagner, in his case, reported an outspoken neuroretinitis with a slightly swollen and indistinctly outlined disk. In several cases, blurring or pallor of the temporal half of the nerve-head was observed. Post-neuritic atrophy was seen in some. Optic atrophy without further details was reported by Pollack and by Meyer. In my own first case, the right eye showed only very indefinite signs of a previous inflammation. In no case was there a papillitis of great intensity. The changes, therefore, may be said to range from a low-grade optic neuritis to an atrophy without definite signs of a previous inflammation. All these appearances can be explained by a low-grade inflammation taking place in some part of the nerve-trunk between the chiasm and the disk, and varying in clinical signs according to the location of the process.

The fields of vision present points of striking interest. Unfortunately, in Pollack's case there is no mention of a perimetric examination. In Moore's, the field of vision could not be mapped out on account of the mental condition of the patient; while in Bolte's case it was normal.

In seven cases, those of Sanesi, Wagner, Meyer, Gourfein-Welt, Berliner, Hennicke and in my own first case, one or both eyes presented evidence of a temporal hemianopsia.

In two cases, Souroff's and my own (Case 2), the changes show a striking similarity. There was a concentric narrowing of the fields, so that in one eye of each patient a paracentral area remained with vision of 2/60 or lower and perception of white and red. In the other eye, there was apparently a central area of vision preserved of 6/21 in Souroff's and 6/60 in my own case, and good perception of colors.

Two cases, those of Schmidt-Rimpler and Burchard, presenting a central scotoma will not be included here, but will be spoken of later.

The condition of the fields in the first seven cases points almost inevitably to pressure on the optic chiasm by an hypertrophy or new growth of the hypophysis — and this finding is in accord with numerous observations made on the relationship between the thyroid gland and the pituitary body.[1]

For a number of years, evidence has been accumulating which points to a close relationship between those glands of the body which possess an internal secretion, and especially between the hypophysis and the thyroid. A study of this evidence shows the following facts: The thyroid gland and the anterior lobe of the hypophysis develop from the same embryonic structures, and show a close histological similarity. Furthermore, in all but exceptional cases of acromegaly the colloid degeneration, with or without cyst formation, which is found in the hypophysis, is also present in the thyroid.

Conversely, Boyce and Beadles, de Coulon, Bourneville and Brisson, Langhans, Ponfick and others have found in myxedema, cretinism and similar conditions, enlargement of the sella turcica and disease of the hypophysis. Rogowitsch, Stieda, Gley and Hofmeister observed enlargement of the hypophysis after extirpation of the thyroid gland.

Schönemann examined a number of cadavers from a region where goiter was common, and although there was no hypertrophy of the pituitary body, he found similar degenerative changes in both organs. Certain chemical studies also support the view of a close relationship between the two.

Clinically, the signs of acromegaly may be combined so closely with those of myxedema that it is hard to decide which set of symptoms is preponderant.

Cases are occasionally found which present a combined picture of exophthalmic goiter and acromegaly (I have had the opportunity of following one of these during the past four years), and signs of exophthalmic goiter, myxedema and hypophyseal enlargement may be present in the same patient at different times, as is evidenced by Bolte's case.

Other glands possessing an internal secretion show a similar relationship. Polyuria, glycosuria and diabetes with changes in the pancreas, have been reported in acromegaly; while one of the commonest accompaniments of pituitary enlargement is the change in the generative organs, as shown by amenorrhea in the female and impotence in the male.

Other recorded facts which are also of interest tend to show that the amount of pathologic change found in these various conditions bears apparently no true relationship to the clinical condition. Hence, we may have greatly enlarged thyroids without the symptoms of exophthalmic goiter; marked atrophy of the thyroid without signs of myxedema; while enlargement of the hypophysis may produce several pictures clinically. It is Uhthoff's[2] view that in youth it produces general disturbances of growth (giantism and dwarfism) not infre-

1. Pineles, in an excellent article (Die Beziehungen der Akromegalie zum Myxoedem . . . Samml. klin. Vortr., No. 242; Inn. Med., No. 73) gives a very full consideration of this subject.
2. Uhthoff: Beitrag z. d. Wachstums-Anomalien b. d. temporalen Hemianopsie, etc., Berl. d. ophth. Gesellsch., 1907, p. 140.

quently accompanied by a general adiposity, but without true acromegaly. Brissaud and Meige hold the view that increase in the function of the hypophysis leads, in childhood particularly, to giantism, in adults to acromegaly, and in later life to thickening of the soft parts.

The question as to how often an enlargement of the hypophysis is sufficient to produce disease of the optic nerve has been investigated, notably by Ottolenghi and by Hitschmann. Ottolenghi[3] examined the fields of vision of thirty cretins, and found no definite change which could be laid to an enlargement of the hypophysis. In no case could he demonstrate a temporal hemianopsia. In three cases, however, he found changes in the fundus; in Case 17, a beginning optic atrophy in each eye; in Case 25 papillitis in each eye; in Case 27 optic neuritis in each eye.

Hitschmann,[4] in an exhaustive research, examined fifty-eight cretins, and came to similar conclusions. He found, however, one case of optic atrophy, which possibly was due to an intercurrent tabes. Hitschmann's fundus observations will be referred to later.

We see, therefore, only in the rarest cases of myxedema, cretinism and similar diseases, an enlargement of the hypophysis sufficient to cause involvement of the optic nerve. It has occurred, undoubtedly, in only seven of the cases, and in some of these, striking symptoms of acromegaly were present.

In Sanesi's case, there were characteristic symptoms of both diseases. Preference was given to myxedema on account of the order in which the symptoms developed and from the success of the treatment with a thyroid preparation.

Wagner's case presented as many signs of acromegaly as myxedema. In it, also, a thyroid preparation was of benefit.

Burchard made the diagnosis of acromegaly combined with partial myxedema, and the case presented by Gourfein-Welt also showed many characteristic features of acromegaly, but was much helped by a thyroid preparation.

Formerly, the enlargement of the hypophysis, which is found in myxedema and allied conditions, was thought to be a compensatory hypertrophy. The enlargement found in these cases, however, is not parallel with that found experimentally in animals after the operative removal of the thyroid gland. It seems more likely here that we have some primary condition which affects both glands, and according to how each gland reacts to the primary disease we get a varying clinical picture ranging from myxedema with pathologic changes in the pituitary body but no clinical symptoms, to acromegaly with degeneration of the thyroid gland, but without symptoms of myxedema. The cases cited here would seem to be representative of this symptom-complex. What makes them so unusual is the fact that the myxedematous symptoms are in the foreground.

There is no reason to doubt, then, that disease of the optic nerve presenting a picture of a temporal hemianopsia occurring in the course of a myxedema is due to an enlargement of the pituitary body.

A further question remains: Will pressure on the chiasm always account for the diseased optic nerve in myxedema?

Berliner ends his study of the subject with the following conclusion: "In pure myxedema, naturally if we exclude accidental complications, an optic atrophy does not occur. It is always the result of a concurrent tumor of the hypophysis. . . ."

If this is so, how can I explain the two cases of concentric narrowing of the field? In one eye of each patient the field was reduced to a small central area around the fixation point, which did not suggest an hemianopic defect. The second eye of my case showed a small rounded paracentral area remaining, also not suggesting hemianopsia. Nor did the field of the second eye in Souroff's case suggest it from the description given. Such fields could hardly be produced by hypophyseal enlargement. And furthermore, if we except the amenorrhea in Souroff's case, neither patient presented signs in accordance with such a process.

The radiographic examination made in my case by a roentgenologist of great experience and skill was negative. In this connection, however, it must be said, that the *x*-ray examination was negative in Hennicke's case also, in spite of the clinical evidence of pituitary enlargement.

In theory, the disease of the optic nerve in these cases might be caused by some toxic or infectious substances, possibly some toxic product of metabolism allowed to work through the diminished antitoxic power of the thyroid secretion. In support of this view, we have the very striking nervous symptoms of myxedema, the loss of memory, slow mental process, listlessness, hallucinations of speech and hearing, even insanity; also weak reflexes, cramps, spasms, frequent headache and reduced temperature.[6]

On the other hand, as Berliner well remarks, why, if this is so, do we not see optic neuritis more frequently in myxedema and in its allied diseases? Also why has there never been found in myxedema a pathologic condition of the central nervous system which can be considered as parallel with an atrophy of the optic nerve?

Another possibility should be mentioned. A general increase of intracranial pressure could cause an optic neuritis and a concentric contraction of the field. If it existed, one would expect, however, a choked disk and other clinical signs which were not present in these cases. It is likewise hard to see how a hypophyseal growth could expand sufficiently to cause increased intracranial pressure without first producing a direct pressure on the chiasm.

The chorioretinitis seen in my second case presents another element of a most unusual character. In appearance, it strongly suggested a syphilitic process from the marked vascular involvement and the striking migration of pigment from the periphery. Syphilis would also explain the disease of the optic nerve. No other evidence could be obtained, however, except that the patient's wife had had one still-born child. There was no scar on the genital organs, no history of miscarriage by his wife, and their only child is 24 years of age and perfectly healthy. On carefully questioning, the patient denied gonorrhea or syphilis, as well as any opportunity for infection. Two separate Wassermann tests carried out by different observers were negative. In spite of this negative evidence, syphilis could not be ruled out, and the patient was put on large doses of mercury and iodid, in the hope of influencing the ocular condition. It cannot be denied, however, that these pathologic changes could be produced by the same hypothetical toxic or

3. Ottolenghi: Cited by Hitschmann (Note 4).
4. Hitschmann: Augenuntersuchungen bei Kretinismus, Zwergwuchs u. verwandten Zustünden, Wien. klin. Wchnschr., 1908, No. 27, p. 655.

6. It may be noted in regard to optic-nerve disease occurring in other diseases of the blood glands that in tetany Marshner has observed a case of neuroretinitis, while Cassel has seen atrophy of the optic nerves (Possek: Schilddruse und Auge, Klin. Monatsbl. f. Augenh., 1907, Beilageheft, p. 1), as has Hanke (Cataract, Neuritis Optica, Degeneration des Pigmentepithels des Irishhinterfläche bei Tetanie, Ber. d. ophth. Gesellsh., 1907, p. 329), also.

infectious agent which may have been responsible for the change in the optic nerve.

Turning to similar changes in other cases of myxedema or allied conditions with optic-nerve disease, Hitschmann in his studies on cretinism noted in Case 4 of his series slight pigment changes in the macula of the right eye; chorioiditis in the macula of the left eye; in Case 6, circumpapillary chorioidal atrophy with pigment deposit. Bolte noted on the edge of the disk of his case, irregular gatherings of pigment. These lesions probably bear little relationship to the changes in my case. Hitschmann, however, presents an observation of greater similarity.

CASE 50.—Patient 19 years old. Right eye floating vitreous opacities, diffuse chorioiditis. Left eye, posterior cortical cataract, floating vitreous opacities, and separation of almost the whole lower half of the retina. About one disk diameter up and out from the nerve-head, there is a large area of chorioiditis with marked pigment deposits; several smaller areas in the neighborhood.

V. R. = 2/60, not improved.
V. L. = distinguishes light at 1.5 meters.

Projection faulty. Field of vision in right eye, concentric contraction. White is seen nasally 45 degrees, on the temporal side over 50 degrees, upward and downward 30 degrees.

Hanke,[8] in a case of parathyroid disease (chronic tetany), examined pathologically, found, besides lenticular changes, the extraordinarily rare complication of a postneuritic optic atrophy, and also a very marked degeneration of the pigment layer of the iris which suggested the changes found in diabetes. He attributed these changes to toxic substances circulating in the blood.

Taking it all in all, I can come to no definite conclusion in regard to the changes in my case. I cannot rule out an intercurrent disease; I cannot prove a toxic cause allied or similar to that of myxedema. One thing seems probable, however, and that is that the process in all probability was not due to hypophyseal enlargement, and I do not believe that the present evidence is sufficient to allow me to agree with Berliner's conclusion in the affirmative.

ABSTRACT OF CASES

CASE 1.—Schmidt-Rimpler[9] reports a case referred to him by Dr. Betke in which later myxedema developed. In each eye there existed a central scotoma for colors, without any discoverable change in the optic nerves, suggesting a retrobulbar neuritis in its early stages. Improvement took place under treatment with a thyroid preparation.[10]

CASE 2.—Sanesi[11] reports the case of a man in whom a myxedematous state developed. There was a characteristic infiltration of the skin and lowering of the intellectual faculties, with atrophy of the thyroid gland. Later bitemporal hemianopsia was found, and persistent headaches developed. Sanesi hesitated between a diagnosis of myxedema and acromegaly. Basing the diagnosis on the group of symptoms that appeared first, he declared in favor of myxedema. Some improvement took place, also, on the use of a thyroid preparation.

CASE 3.—Wagner[12] reports the case of a woman, 26 years old, with bloating of features and hands. Intelligence was reduced. Speech was difficult. Amenorrhea was present. There was neuroretinitis of the right eye, vision equaled 1/10. Field of vision was apparently free. The nerve-head of the left eye was white, vision equaled 1/10. There was marked temporal hemianopsia. Diagnosis: myxedema; acromegaly, however, was not absolutely excluded. There was considerable improvement under thyroid treatment.

CASE 4.—Burchard[13] reports the case of a woman aged 23. There was swelling of features and hands. Intelligence was reduced. Amenorrhea was present. There were paresis of the right inferior rectus, temporal pallor of the right optic nerve-head and a central color scotoma. Diagnosis: acromegaly combined with partial myxedema.

CASE 5.—Bolte[14] reports a case of myxedema with marked nervous symptoms. There were dizziness and twitching of limbs. At first, there were signs of exophthalmic goiter, followed by those of myxedema. There was slight optic neuritis of both eyes with fields unchanged. The patient improved under thyroid preparation.

CASE 6.—Pollack.[15] Girl, aged 9. There was optic atrophy of both eyes and vision was markedly reduced. The condition improved much under thyroid treatment.

CASE 7.—W. Meyer[16] reported in discussion a case observed by him in Breslau. In a small boy with optic atrophy and a bitemporal hemianopsia myxedema developed. Von Mikulicz found a complete absence of the thyroid gland. Vicarious enlargement of the hypophysis was believed to have taken place. A considerable improvement followed the use of a thyroid preparation.

CASE 8.—Gourfein-Welt.[17] Woman, aged 47. There were loss of sight, psychic changes, marked signs of myxedema, reduction of vision in both eyes, an apparent slight optic neuritis in the left eye, temporal hemianopsia and enlargement of the sella turcica. Marked improvement resulted under thyroid treatment.

CASE 9.—Moore.[18] Man, aged 44. There were very marked loss of sight, general signs of myxedema, tremor of the hands and atrophy of the optic nerve of both eyes. There was improvement under thyroid treatment.

CASE 10.—Berliner.[19] Female, aged 26. There were loss of vision, general signs of myxedema, amenorrhea and atrophy of the temporal half of the right optic disk and of the left optic disk. Vision was much diminished. Probable hemianopic defects were present. Improvement resulted under thyroid treatment.

CASE 11.—Souroff.[20] Woman, aged 43. There were general signs of myxedema. V.R.=1/ ∞; V.L.=20/70. There was eccentric contraction of the visual fields and pallor of the right optic disk. Improvement resulted under thyroid treatment.

CASE 12.—Hennicke.[21] Woman, aged 53. There were general signs of myxedema, diminution of vision and slight optic neuritis. The general condition improved under thyroid treatment, but the eyes seemed to grow worse.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. DE SCHWEINITZ AND HOLLOWAY AND DERBY

DR. T. B. HOLLOWAY, Philadelphia: Concerning the visual field phenomena in pituitary lesions, it is difficult to state the exact cause that may be operating to produce various changes. The factor that is most frequently regarded as responsible is direct pressure on the chiasm or on some portion of the visual tract, and in this connection the possibility of cysts must not be overlooked. Localized meningitis, toxemia, hemorrhage in or about the growth, and areas of softening due, possibly, to

9. Schmidt-Rimpler: Die Erkrankungen des Auges im Zusammenhang mit anderen Krankheiten, Wien, 1898, p. 382.
10. As this thyroid preparation used is a proprietary which has not been passed on by the Council on Pharmacy and Chemistry, the name by which it is known commercially is here omitted.—ED.
11. Sanesi: Miasoedema spontaneo degli adulti, Clin. med. Ital., 1899. Cited by Gourfein-Welt.[17]
12. Wagner: Augenerkrankungen bei Myxoedem, Klin. Monatsbl. f. Augenh., 1900, p. 473.
13. Burchard: Ein Fall von Akromegalie kombiniert mit Myxoedem, Petersb. med. Wchnschr., 1901, p. 481. Cited by Berliner.[19]
14. Bolte: Beitrag zur Kausistik des Myxoedems, Char. Ann., 1903, xxviii.
15. Pollack: Fall von Myxoedem mit Sehnerven-atrophie, Verhandl. d. Berl. Ophth. Gesellsch., Centralbl. f. prakt. Augenh., 1905, p. 359.
16. Meyer, W.: Verhandl. d. Gesellsch. deutsch. Naturforscher u. Aerzte zu Stuttgart, 1906, ii, 234. Cited by Berliner (Note 19).
17. Gourfein-Welt: Lésions oculaires dans le myxoedème spontané des adultes, Arch. d'Ophth., 1907, p. 561.
18. Moore: Myxedema with Optic Atrophy, Proc. Roy. Soc. Med., May, 1908, p. 194.
19. Berliner: Opticusatrophie bei Myxoedem, Inaug. Dissert., Freiburg i. Br., 1909.
20. Souroff: A Case of Simple Myxedema Complicated by Atrophy of the Optic Nerve, Westnik. Ophthal., xxvi, 637. I am indebted to Dr. M. J. Konikow of Boston for a literal translation of this article.
21. Hennicke: Augenerkrankung bei Myxoedem, Klin. Monatsbl. f. Augenh., November, 1911, p. 589.

thrombotic processes may also be considered, and the last two conditions especially in the presence of probable disease of the basal vessels. Finally, there is another factor which we believe an important one in determining some of these changes; I refer to constriction of a part of the visual tract by some portion of the circle of Willis.

Concerning Zander's observations on the normal position of the chiasm, it will be recalled that this structure was found on one side or the other of the median line in about 60 per cent. of the cases, and it was also usually situated so that the hypophysis came to lie anteriorly. Despite these findings Bartels states that in an analysis of thirty-nine autopsies, but three growths, those of Sachs, Uhthoff and Erdheim—to which may be added a later case observed by Moskalew—were found anterior to the chiasm. He explains that growths situated beneath or anterior to the chiasm cause a constriction of the optic nerves by pressing these structures against the overlying anterior cerebral arteries, whereas those situated posteriorly to the chiasm would compress this structure between the growth and the structure situated anteriorly, and cause the optic tract to be compressed by the carotid artery.

Inasmuch as deep lesions may produce constriction of the visual tracts, it seems possible that higher basal lesions might also produce constriction of these tracts by pressing some portion of the vascular circle downward, especially if we recall that this pressure may be sufficient to cause an enlargement of the sella turcica, as has been observed by Oppenheim in a case of hydrocephalus. In fact, Türck has observed an indentation of the optic tract by the posterior communicating artery as the result of acute hydrocephalus. This naturally brings us to the most interesting observation by Foster Kennedy, concerning the existence of retrobulbar neuritis as a diagnostic sign in certain tumors and abscesses of the frontal lobe. He points out that in the presence of a growth in the frontal lobe there may exist a central scotoma and optic atrophy on the side of the lesion, associated with a contralateral choked disk, these changes being brought about by pressure of the growth on the optic nerve.

DR. F. H. VERHOEFF, Boston: Drs. de Schweinitz and Holloway have pointed out that a central scotoma occurs in hypophysis enlargements more often than is generally supposed, but they are unable to offer a satisfactory explanation of the fact. A case in which I performed a necropsy five years ago seems to throw considerable light on the question although it was not one of hypophysis disease. In this case there was sclerosis and thinning of the wall of the internal carotid artery leading to compression of the optic nerve at its exit from the optic canal. On examining the nerve microscopically by suitable methods, I was surprised to find that the papillomacular bundle was completely degenerated whereas the remainder of the nerve was little affected. This shows quite conclusively, it seems to me, that pressure on the nerve anywhere may affect the papillomacular bundle first, which affords a probable explanation of the central scotoma in hypophysis disease. It accords with the fact that this bundle is specially sensitive to deleterious influences. Possibly if the pressure was pulsating, owing to a vessel being pressed against the nerve by the growth, as in cases cited by Drs. de Schweinitz and Holloway, the effect on the papillomacular bundle would be especially pronounced.

DR. F. PARK LEWIS, Buffalo: I think it important to report seemingly unusual cases, as such cases when brought to our notice not infrequently are duplicated in the practice of others oftener than we realize. The remark made by Dr. de Schweinitz and emphasized by Dr. Holloway, that the selective affinity of toxins for various groups may be found otherwise than in the macular bundle, seems to me will bear still further emphasis. A case in point was an eclampsia the results of which came to my notice which on recovery left permanently a field limited by an exactly horizontal line just escaping the macula. That occurred three years ago and from that time to the present the entire lower half field has been lost. Another case which leads me to believe that possibly involvement of the optic nerve in cases of myxedema is not so uncommon as we may think is one which came under my observation a dozen years ago, which is worth reporting for two reasons: first, because of an involvement of the optic nerve with loss of vision to about one-fourth which largely improved under the use of pituitary extract. The theory on which it was given was that there was a hypertrophy of the pituitary with limited secretion and by giving the extract this would be replaced. Whatever may have been the truth of the theory, the fact was that under the administration of the pituitary extract, continued throughout a period of two years, the vision was improved to about one-half, at which it remained. While the patient not gaining further, was lost sight of, I have every reason to believe the vision has remained at about one-half.

DR. T. B. HOLLOWAY, Philadelphia: Dr. Verhoeff's observation on the optic nerve confirms Kennedy's interesting observation that pressure of the brain on the nerve was responsible for the central scotoma, inasmuch as he regarded the papillomacular bundle as being the most sensitive of the various tracts.

VISUAL DISTURBANCES FROM DISTANT HEMORRHAGE

WILLIAM ZENTMAYER, M.D.
PHILADELPHIA

Disturbance of vision from loss of blood is of comparatively rare occurrence. Dufur found it but once in 30,000 eye cases. But the fact that hemorrhage from almost any part of the body and arising from almost any cause may have this grave sequel makes the condition one of considerable importance to the surgeon, internist and ophthalmic surgeon.

The exhaustive analysis made by Singer of the 198 cases of disturbances of vision following loss of blood, appearing in literature up to 1901, together with a study of those since reported, demonstrate the great diversity of the ocular phenomena, and indicates that the pathogenesis is not the same in all cases.

FACTORS IN THIS CONDITION

Sex.—It occurs with greater frequency in females than in males, principally for physiologic reasons, but the more frequent occurrence in males of intestinal hemorrhage from ulcer of the duodenum tends somewhat to equalize the relative frequency of its occurrence in the sexes.

Age.—The decades between 20 and 50 years furnish most of the cases and in the earlier of these the women are in the majority for the same reason of its more frequent occurrence in this sex.

Occupation and Station in Life.—Perhaps neither of these is a consequential factor. The latter may be of some importance as in the poorly nourished a hemorrhage might have more effect on the delicate structures of the retina than in the robust.

Time of Occurrence.—In many cases the visual disturbance comes on immediately or within the first few hours following the hemorrhage, but in some cases the vision fails gradually, reaching its lowest after many weeks.

Effects on Visual Acuity.—In 88 per cent. both eyes were affected, in 12 per cent. one eye. In the bilateral cases 59 per cent. of patients were totally blind. In 32 per cent. there was amblyopia in each eye and in 9 per cent. there was amaurosis in one eye and amblyopia in a differing degree in the other.

Field of Vision.—Of the cases in which the histories recount the changes in the visual fields, in 21 per cent. there was peripheral contraction. In 3.7 per cent. there was marked nasal contraction. In 7.4 per cent. the

upper field was lost, in 23 per cent. the lower field was lost. In 10 per cent. there was hemianopsia. In a certain percentage of these it is a question whether it was not a simulated hemianopsia in optic nerve atrophy. In 13 per cent. there was a central scotoma.

Ophthalmoscopy.—In a few cases the ophthalmoscopic changes were either negative or slight. In the remaining cases there was either beginning neuritis, decided neuritis, papilledema or optic atrophy, either primary or consecutive. Other changes noted were edema of the retina and hemorrhages.

Prognosis.—A. Relative to time of hemorrhage. Of the cases in which the visual disturbance was coincident with the hemorrhage, improvement occurred in 22 per cent.; of those in which it occurred within the first twelve hours improvement in 71 per cent.; between 12 hours and ten days 41.5 per cent., and after the ten days 50 per cent.

B. Relative to the nature of the hemorrhage. No improvement or a deterioration took place in 51 per cent. of the cases of intestinal hemorrhage; in 42 per cent. of uterine hemorrhage, in 62 per cent. of nasal hemorrhage, in 48 per cent. of hemorrhages from wounds.

C. Relative to the nature of the visual defect. Apparently those cases with central scotoma gave the best prognosis.

Condition of the Patient at Time of Hemorrhage.—One of the most interesting questions in connection with this subject is the condition of the patient previous to and at the time of the hemorrhage. In many of the reported cases the patient was said to be strong and in good health. But naturally, in very many the underlying cause of the hemorrhage or the repeated hemorrhages culminating in the visual disturbance had greatly lowered the power of resistance.

Nature of the Hemorrhage.—There may have been but a single hemorrhage or there may have been several hemorrhages. The quantity of blood lost has varied from a slight amount to a profuse exsanguinating loss.

Source of the Hemorrhage.—As has been stated above, hemorrhage from any source may cause defects in the vision, but in fully 70 per cent. the bleeding was from the gastro-intestinal tract and uterus. Other causes are hemoptysis, venesection, cupping, epistaxis, wounds, hemorrhage from the gums following extraction of teeth, and from the urethra.

Considering the frequency of the occurrence of severe hemorrhage on battlefields, after lacerated wounds incurred in occupations, and formerly during extensive surgical operations, and the rarity with which any of these enter into the etiology of visual disturbance following loss of blood (DeWecker and Knies did not observe a case in the Franco-Prussian War), one is forced to the conclusion that there is some other factor in its production than the resulting anemia. Certainly it does not seem reasonable to consider a man to have been in good health, as has been done in some of the case histories, who suffers a severe gastric or enteric hemorrhage. Usually such hemorrhages result from an ulceration consequent on a chronic inflammation of the stomach or duodenum which had in its train, malnutrition, anemia, nervousness and insomnia from indigestion and autointoxication. Nor can those cases occurring after venesection be looked on as the result of simple anemia, as no perfectly healthy individual requires blood-letting. Many of the cases of uterine hemorrhage occurred in pregnant women and followed abortion, premature birth, placenta prævia, extraction of the placenta or retained membranes or were associated with uterine growths—all conditions likely to be associated with the generation and absorption of toxins. There remains a large group of cases in which no thorough physical examination was made, the dependence of the ocular symptoms on the hemorrhage seeming so conclusive that a search for the predisposing cause was neglected. I am quite certain that in one of my own cases only the careful study of the patient by a competent neurologist would have resulted in the discovery of the cerebrospinal symptoms and only by our modern clinical methods could the syphilitic nature of the condition have been determined, as the patient had denied infection.

In the other case the history, supplied by Dr. Tyson, gave the clue to the contributing factor, but direct dependence of the amblyopia on the uterine hemorrhage and the absence of renal symptoms at the time of the visual disturbance, might have caused the previous existence of a nephritis to have been overlooked.

PATHOLOGY AND PATHOGENESIS

In the case examined by E. Ziegler there was a decided fatty degeneration of the connective elements of the retina and optic nerve, especially in the scleral portion. No inflammatory products were found, so that he concludes that the changes are those of ischemic degeneration.

Weeks says that "it is to-day fully recognized that the blindness is due to degeneration of the ganglion cells, primarily because of interference with their nutrition;" but, as Holden has said, there are cases in which the clinical findings cannot be thus explained, and Gowers and De Lapersonne admit that the pathogenesis is not the same in all cases. Wildbrand and Sänger say that we know nothing definitely concerning the pathogenesis. As but three cases have been studied microscopically, in two of which considerable time had elapsed since the hemorrhage, and none of these since the employment of modern staining methods, we are therefore largely dependent on animal experimentation for our knowledge of the changes induced in the eye by the loss of blood. These experiments first made by Holden demonstrated degeneration of a number of retinal ganglion cells together with their long processes which make up the centripetal fibers of the optic nerve.

Von Graefe supposed that a hemorrhage occurred into the optic nerve-sheath or into the interstitial tissue of the nerve. As pointed out by Carlini, this would not explain those cases in which the amaurosis occurred late. Leber modified this theory by adding the possibility of an acute inflammation or extravasation affecting also the base of the brain. Horstmann considered those cases following epistaxis to be due to meningitis followed by a descending optic neuritis. Samelsohn's explanation is that the cerebral anemia leads to an increase in the ventricular and subarachnoid fluid. With a refilling of the cerebral vessels the fluid is forced into the lymph-spaces of the optic nerve causing an optic neuritis with increase in the interstitial tissue and pressure on the central vessels and finally optic atrophy. Litten's case of amblyopia with optic neuritis following the removal of an ascites lends support to the theory of Samelsohn; and this is a tenable theory for cases accompanied by papilledema.

Knies believes that a retrobulbar neuritis develops as the result of extravasation from vessels with diseased walls—an explanation that might be accepted for cases in which there are primarily no visible ophthalmoscopic changes but later atrophy of the optic nerve.

Ziegler explains those cases occurring after slight hemorrhages as due to contraction of the vessels from

excitation of an impressionable vasomotor system. Theobald gives as a possible cause, in some cases, thrombosis of the central artery of the retina and of the cavernous sinus.

Undoubtedly the theory of retinal ischemia with degeneration of the ganglion cells, supported as it is by animal experimentation, best explains the majority of cases, but does not apply to cases in which the amblyopia does not come on until after the time when the normal circulation has been restored. Neither does it explain cases of true hemianopsia, or true papilledema, or rare cases of which Carlini's is an example in which no fundus changes were noticed as late as two months after the hemorrhage, but nevertheless a quadrantanopsia had resulted.

Cortical changes are the probable cause of homonymous hemianopsia. A study of the visual fields shows that there are groups of cases in which the fields are representative of the fields seen in the different forms of toxemia and that there is an exceptionally large group (the superior and inferior pseudohemianopsias) in which the fields differ greatly from any of the types significant of toxemia.

It seems impossible to reconcile these widely differing findings with a theory which would attribute all to one pathogenesis. In this connection it is interesting to recall that a similar pathogenesis has been advanced and largely accepted for the amblyopia produced by quinin and some other toxic agents, but that the question of the primary lesion in tobacco-alcohol amblyopia may still be considered *sub judice* is shown by the consideration of the subject in the 1912 edition of Fuchs' text-book. The similarity of the fields in some of the cases of amblyopia from loss of blood with those found by Rönne in various forms of optic nerve atrophy and in glaucoma and which he attributes to the anatomic arrangement of the optic nerve fibers in the retina and therefore indicative of the lesion being in the optic nerve rather than in the ganglion cells of the retina is of further interest in relation to this question.

From a purely theoretical consideration of the question it would seem plausible to assign retinal ischemia with degeneration of the ganglion cells of the retina as an explanation of those cases showing peripheral contraction and in some cases central scotoma; retrobulbar neuritis for those with central scotoma with little impairment of the extent of the field, and cortical lesions for those with true lateral hemianopsia, and those showing no changes in the papilla after the lapse of sufficient time for atrophy to have set in from either retinal or retrobulbar involvement, and simple atrophy or postneuritic atrophy for those with marked superior or inferior contraction of the fields.

There are several known facts in connection with ischemia of retina which invalidate in a measure the application of this theory even to all of the cases with contracted fields. They are: that several cases are known in which blindness from this cause has been fully recovered from, after persisting for many hours; that the blindness in spasm of the central artery of the retina is coincident with the spasm; and that in quinin amaurosis, in which ophthalmoscopically the ischemia is evident, vision usually improves after a time, whereas in amblyopia from hemorrhage the impairment of vision is often late in appearing and rarely improves.

As Knies has said concerning a predisposing cause leading to the amblyopia, the affected individuals are either not in vigorous health or are positively ill; and often, as Haab intimates, there is present an abnormal condition of the blood. These are not only undoubted factors in the production of the amblyopia but also in the modification of the phenomena usually associated with retinal ischemia.

TREATMENT

As failure of vision is often delayed for some days it is important that prophylactic measures be taken in all cases of severe hemorrhage. In the few instances in which hypodermoclysis, or the injection of blood-serum, has been employed on the first sign of visual disturbance the results have been such as to encourage the belief that, except in those cases in which the blindness and the hemorrhage occur simultaneously, the immediate employment of such measures as the above may prove of value. The after-treatment should consist in the use of chalybeates, and vascular and nerve-stimulants.

REPORTS OF CASES

My own cases are the following:

CASE A.—*Patient.*—Mrs. S. K., aged 24, was sent to me by Dr. James Tyson, Feb. 26, 1896. One year previously she had had puerperal nephritis but had recovered from this. A few weeks before consultation, during a rather severe metrorrhagia, the eyesight became suddenly affected. She thought that there had been some slight impairment after the confinement the previous May but that distinct failure of vision dated from four attacks of bleeding, each lasting three or four days, occurring within the past six weeks.

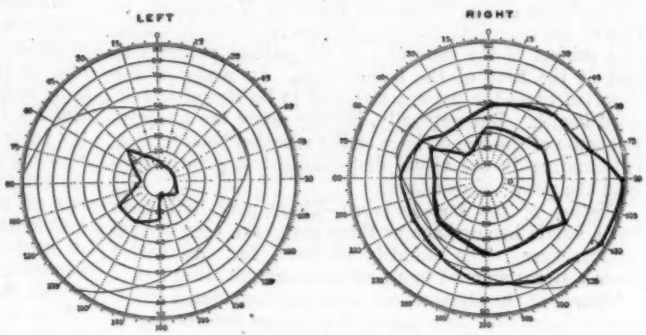

Fig. 1.—Form and red field, right, and form field, left, Case A, Mrs. K., Feb. 26, 1896.

Examination.—The refraction and vision acuity were as follows:

O. D. $-0.50 \bigcirc + 4.25$ c. ax. 110° 5/9
O. S. $+0.75 \bigcirc + 0.75$ c. ax. 90° 5/12

Pupils were equal. Irises responded sluggishly to light and accommodation. In both eyes the papillæ were very pale; arteries and veins about normal. Scattered throughout the retina were a very few minute, discrete yellowish points. In the right eye there were but three or four while in the left eye there were several between the papilla and macula. There were neither splotches nor hemorrhages present. The field of vision in the right eye showed some contraction up and in (Fig. 1, right); that of the left eye was very small and of irregular shape, being contracted to within 10° of fixation both to the temporal and nasal sides (Fig. 1, left).

Course.—She was under observation four months. At the end of that time the left optic papilla was distinctly atrophic. Vision was, in the right eye 5/6; left eye 5/7.5. The field of the left eye had gradually widened, finally assuming an almost typical hemianopic form (Fig. 2). Dr. Tyson's notes

show that Mrs. K. came under his care in April, 1895. There was a history of hematuria three years previously. She had been married three years. The first child went to term thirteen months after marriage. She had been pregnant since October, 1894. In April, 1895, the urine was 8/10 bulk albumin, with numerous casts; specific gravity 1.025. She miscarried at the eighth month. The amount of albumin gradually diminished and in September, 1895, there was a bare trace; "would pass as normal." The urine remained free from albumin and casts up to the time she passed from under observation, June 18, 1896. Dr. Barton Cook Hirst's examination showed a subinvoluted uterus, pulled to the left side and backward by adhesions, but not turned over backward.

CASE B.—*Patient.*—C. H., male, aged 36, ice-cream maker, came to Wills Hospital Jan. 2, 1912, because of failing sight. For the previous six years he had been treated from time to time for the relief of symptoms of chronic gastric catarrh. Shortly after midnight of Nov. 5, 1911, he had a severe hemorrhage from the mouth, apparently coming from the stomach. He was seen at 2 a. m. by Dr. A. B. Reader of Camden, N. J., to whom I am indebted, in part, for the following notes of that illness. The hemorrhage had been very large, according to the patient's statement, at least a pint. One week later he had a second hemorrhage when about half as much blood was lost. Repeated examination of the stomach contents showed the presence of large quantities of hydrochloric acid, as much as 0.21 per cent. Occult blood showed in the stools one week after the hemorrhage and persisted for four weeks. The anemia following the bleeding was very marked until quite recently. During the second week, that is after the second hemorrhage, he complained of difficulty in keeping his eyes open and of failing vision. By the sixth week he was

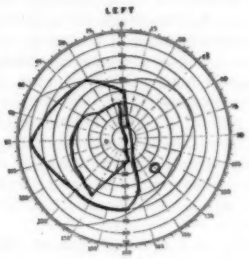

Fig. 2.—Form and color fields, left eye, Case A, Mrs. K., June 18, 1896.

able to be up and dressed. After the hemorrhage he had considerable pain over the bridge of the nose and in the frontal region. It was, however, not until the fourth week that he noticed the decided impairment of the vision of the right eye, and one week later that of the left eye. According to the patient's statements, there is nothing in the previous personal or in the family history relevant to the present trouble.

Examination.—Vision was, in the right eye, 6/150; in the left 6/6. The right pupil was oval 4 by 5 mm., long axis 30°, eccentric down and in. The left pupil was round, 5 mm. in diameter. Both irises reacted to light and convergence. Both optic papillæ showed extreme atrophic pallor, the arteries were somewhat reduced in diameter, especially the superior branch in the right eye. The veins were about normal in appearance. The edges of the disks and the laminæ cribrosæ were well defined. At the upper margin of the right disk there was an area of superficial disturbance of the chorioid. Both visual fields were greatly contracted, the lower half of the right field including fixation, and almost the entire lower half of the left field being completely gone (Fig 3).

The patient was sent to Dr. T. H. Weisenburg for examination, who reported as follows: "There is a weakness of the lower part of the left face with protrusion of the tongue to the left and lessened action of the palate. Power in all of the limbs is less than it should be and the reflexes are very prompt but there is no Babinski. There is some ataxia in the finger to the nose-test in the left upper limb, and station is somewhat impaired but the gait is normal. There is a history of girdle pains and occasional pain of a shooting character in the thighs and upper limbs. Wassermann reaction positive. Blood examination normal. Considering the multiplicity of the lesions it is possible that the patient has cerebrospinal lues." Dr. Weisenburg has called my attention to the fact that gastric hemorrhage has been reported as a crisis in tabes dorsalis.

Course.—Dr. Reader was informed of the results of the examination and was advised to use antisyphilitic remedies. I subsequently learned that the patient had been given salvarsan intravenously as a part of this treatment. The patient was last seen Feb. 19, 1912, about two weeks after the use of the salvarsan. Vision was unchanged. The visual fields showed further contraction. The fundus showed no alteration.

CASES IN LITERATURE

Following is an abstract of the cases of disturbance of vision following distant hemorrhage which I have been able to find in literature of the past ten years. This, in connection with the paper of Singer gives a fairly complete bibliography of the subject to date:

CASE 1.— Frankel,[1] 1901. Male, aged 46. Gastric hemorrhage; visual disturbance fourteen days afterward. Right eye papilla blurred, arteries irregular in caliber. Left eye, margins of papilla better defined. Right eye remained blind; left eye concentrically contracted field. Some improvement. Author believes that in unilateral atrophy local arteriosclerosis plays a part.

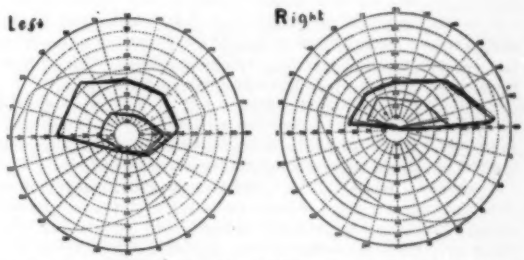

Fig. 3.—Form and red fields, Case B, Mr. H., Jan. 16, 1912.

CASE 2.—Spiller,[2] 1901. Male, aged 51, apparently healthy and strong. Severe repeated gastro-intestinal hemorrhage. On regaining full consciousness, fourteen days later, left eye blind, right eye impaired. Ophthalmic examination two months later showed middle-grade gray atrophy of papilla. Left eye blind; right eye 6/6. No further change occurred. Marked general arteriosclerosis.

CASE 3.—Laqueur,[3] 1903. Female, aged 39. Hemorrhage from stomach. Right eye blind six days after hemorrhage. Atrophy of the papilla. Later, fingers counted in temporal field.

CASE 4.—Gallemaerts,[4] 1904. Female. Metrorrhagia. Visual disturbance began four days later. Complete optic atrophy on one side, incomplete on the other.

CASE 5.—Snell,[5] 1904. Female, aged 28. Hemorrhage from retained placenta. No albumin. Atrophy of the optic nerve.

CASE 6.—Stirling,[6] 1904. Male, aged 6. Hemorrhage after extraction of tooth lasting three or four days. Previous attack of excessive bleeding. Visual disturbance immediately on regaining consciousness. Vision in right eye, fingers at 6 inches. Field concentrically contracted to within 15°-20° of fixation. Right eye, postneuritic atrophy. Papillæ chalky-white. Arteries diminished in size.

1. Frankel: Med. Woche, No. 17, 1904.
2. Spiller: Thèse de Kiel, 1901.
3. Laqueur: Klin. therap. Wchnschr., 1903, No. 23.
4. Gallemaerts: Policlinique, October, 1904.
5. Snell: Tr. Ophth. Soc. U. Kingdom, xxiv, 186.
6. Stirling: Ophth. Rev., 1904.

CASE 7.—Felix,[7] 1905. Female. Uterine hemorrhage from abortion. Right eye remained blind; left eye recovered central vision. In the field there were scotomatous areas.

CASE 8.—Carlini,[8] 1906. Male, aged 23. Traumatic hemorrhage from radial. Unconscious with convulsions. Next day complete blindness, pupils react. Two months later left homonymous inferior quadrant hemianopsia. Right eye, 5/50; left eye, 5/50. Fundus was and remained absolutely normal in appearance. Author assumes an edema affecting both cortical centers.

CASE 9.—Porell,[9] 1908. Female, aged 16. Metrorrhagia. Complete and permanent blindness. Papillæ chalky-white.

CASE 10.—Marquez,[10] 1908. Female, aged 25. Hemorrhage following extraction of a tooth, lasting six days. Both eyes blind. Optic atrophy. Author attributes it to lowered blood-pressure, intra-ocular tension assisting in the impairment of the retinal circulation.

CASE 11.—Marek,[11] 1909. Female, aged 46. Intractable uterine hemorrhage for eighteen months. Failure began one year after onset of illness. Right eye, 5/20; left eye, 5/15. Fields concentrically contracted. Low-grade optic neuritis. Rapid improvement in all conditions after removal of uterus. Fields remained contracted.

CASE 12.—Bistis,[12] 1909. Male. Severe epistaxis. Right eye, 1/6; left, 1/2. Visual fields contracted. Postneuritic atrophy.

CASE 13.—Bistis.[12] 1909. Female. Severe uterine hemorrhage following attempt at abortion. O. D. 1/10. Absolute central scotoma without peripheral impairment. Postneuritic atrophy.

CASE 14.—Moore,[13] 1911. Female, aged 56. Repeated hemorrhages from the stomach. Visual disturbance five days later. Both eyes blind. No subsequent improvement. Papillæ very white. Vessels small. "Railway-truck" appearance of vessels on pressure.

CASE 15.—Moore,[13] 1911. Male, 43 years. Recurring hemorrhages from stomach. Few hours after second hemorrhage left eye blind; four days later right eye blind. Later, hand movements. Papillæ pale and blood-currents very pale.

CASE 16.—Moore,[13] 1911. Male, aged 41. Hemorrhoids for ten years. Right eye counts fingers at 1 foot; left eye 3/60. Both eyes, visual fields full. Complete central scotoma averaging 10° in right eye; partial central scotoma in left eye.

CASE 17.—Moore,[13] 1911. Female, aged 34. Hemorrhage following miscarriage. Visual disturbance day after hemorrhage. In ten days right and left eye blind; eight weeks later, right eye, hand movements; left eye, 6/18; field irregularly contracted to 20°. Small upper-temporal field four months later, no change. Both papillæ pale and edematous. In right eye, +2.50 D.; in left eye, 5+1.50 D. Later, little change in vision but less swelling of papillæ.

CASE 18.—Zentmayer, 1912. Male, aged 36. (Case B. reported above). Two severe hemorrhages from stomach. One week from first, or immediately after second, vision began to fail. Seen nine weeks from this time. Right eye, 6/150; left eye, 6/6. Inferior hemianopsia with preservation of fixation in O. S. Papillæ atrophic. Arteries somewhat contracted. Some nervous symptoms suggestive of cerebrospinal lues. Wassermann positive.

CASE 19.—Zentmayer, 1912. Female, aged 24 (Case A, reported above). Metrorrhagia following puerperal nephritis. Vision began to fail during the course of several hemorrhages. Right eye, 6/10; left eye, 6/18. Papillæ pale, arteries and veins about normal. Right eye, slight contraction of field up and in, left eye, small irregular central field. Four months later vision improved. Field of left eye almost typically hemianopsia.

CASE 20.—Weeks,[14] 1911. Male. Hemorrhage from stomach, single severe. One eye blind, other 20/50. Concentric contraction.

CASE 21.—Weeks,[14] 1911. Female. Uterine hemorrhage more or less constant for fourteen days. Counts fingers at 2 feet.

CASE 22.—Hegner,[15] 1912. Hemorrhage from stomach. Total blindness. Postneuritic atrophy.

CASE 23.—Hegner,[15] 1912. Hemorrhage from stomach. Total blindness. Postneuritic atrophy.

CASE 24.—Hegner,[15] 1912. Hemorrhage from the stomach. Left eye blind; right eye marked defect in visual field. Author attributes visual trouble to ischemia of optic nerve, and retina the result of the anemia.

ABSTRACT OF DISCUSSION

DR. E. C. ELLETT, Memphis, Tenn.: Two years ago I published a report of a case similar to this, but probably on account of the title Dr. Zentmayer has overlooked it. It is interesting not only on account of the changes in the optic nerve, such as Dr. Zentmayer has cited as being present in the twenty-four cases from the literature, but there was also pigmentary degeneration of the retina, associated with retinitis proliferans. The patient, who was observed in 1903, drank a good deal of whisky, and ultimately died of uremia, so that I presume at that time he had a nephritis. There was a history of hemorrhage, but the patient said it was from the bowel, and his physician said it was from the genito-urinary tract. The patient was in bed about three weeks, and it was therefore three weeks after the hemorrhage before I saw him, at which time he complained of blurring of the vision in one eye. I examined the eye-ground but could find nothing to explain the blurring. Unfortunately, I did not take the field of vision. He was going south for his health and I referred him to Dr. Bruns, who found a few retinal hemorrhages, about two weeks after my visit. In the paper I summarized what I understood to have happened as follows:

"We had a general hemorrhage or hemorrhages, followed by edema, and then hemorrhages of the retina, not coming on for some weeks. As a result of this hemorrhage a degeneration of the retinal ganglion-cells followed, that in time leading to atrophy of the retina and optic nerve. As features of the atrophy of the retina, we note liberation of retinal pigment with massing of it in the intercellular spaces and vessel walls in the degenerated area. The irritation of the retinal hemorrhages produced a proliferation of the retinal connective tissue elements. In the eye-ground the pallor of the nerve and wasting of the vessels can be seen, while the accumulation of retinal pigment in a ring shape around the disk marks the extent to which the retinal degeneration had approached the nerve, near which, of course, nutrition was best preserved. Within the pigmented ring the retinal epithelium is preserved. Outside of this ring the chorioidal circulation is made visible by the removal of the pigment layer of the retina."

DR. HIRAM WOODS, Baltimore: To note all conditions present by modern laboratory methods of diagnosis is necessary, because blindness from distant hemorrhage is very rare, and profuse hemorrhage very frequent; consequently there must be something beside the hemorrhage. Toxemia is to be considered, because (1) toxic symptoms are noted in all the troubles producing the hemorrhage—duodenal ulcer, uterine disease, etc.; (2) toxemia is common in the disorders for which venesection is done and venesection has been followed by blindness; (3) the variety of blindness observed is such as we see in toxic conditions—central scotoma, field scotoma, hemianopsia, etc. It is not claimed that this is entirely satisfactory, but it is suggestive. Even in cases of blindness following hemorrhage from tooth extraction, when the individual was thought to be in normal condition, the reason for the hemorrhage is still missing. We know very little about the causes of profuse bleeding after such slight injuries, but its occurrence indicates something wrong with the health. Fuchs gives as causes of blindness in such cases protracted inflammation, embolism and thrombosis. In such cases, the nerve-head itself shows secondary atrophy. Fuchs does not mention profuse, distant hemorrhage as the cause of retinal anemia or atrophy. He does, however, give as a cause of optic

7. Felix: Arch. d'ophth., xxv, 73.
8. Carlini: Clinica Oculistica, February, 1906; Ann. Ophth., April, 1906.
9. Porell: Medicin. Klin., Nov. 13, 1908.
10. Marquez: Siglo Med., Jan. 4, 1908.
11. Marek: Wien. klin. Wchnschr., June 10, 1909.
12. Bistis: Arch. d'ophth., January, 1908.
13. Moore: St. Barth. Hosp. Rep., xlvi, 179.
14. Weeks: Text-Book, 1911.
15. Hegner: Klin. Monatsbl. f. Augenh., January, 1912, p. 119.

neuritis "acute anemia after great loss of blood, the most frequent variety being that due to hemorrhage of the stomach and to metrorrhagia." In other words, Fuchs puts the primary ocular manifestation of the distant hemorrhage in the nerve. The fact that, in twenty out of twenty-four cases quoted from literature, there were definite nerve lesions, papillitis, postneuritic atrophy and simple atrophy, to my mind, strengthens Dr. Zentmayer's hypothesis that retinal ischemia, with degeneration of the retinal cells, may account for cases showing peripheral contraction, and possibly some of the cases of central scotoma, but that retrobulbar neuritis, or neuritis with secondary atrophy, due to a variety of intracranial lesions, more thoroughly explains clinical findings.

Another hypothesis is tenable, and it corresponds somewhat closely with the theory of cell degeneration from ischemia. Case histories indicate that in a certain number nerve lesion is observed late. The order of pathologic changes given by Samelsohn and quoted by Dr. Zentmayer might explain the hemiopic cases on the theory of ischemia. Some vision was spared because the secondary atrophy was slight, while the cortical cells were killed by lack of nutrition. Again, degeneration of retinal cells would be explained by cutting off nutrition through pressure on the vessels during the atrophic process in the nerve.

DR. SAMUEL THEOBALD, Baltimore: Dr. Zentmayer referred to the suggestion which I made several years since as to the etiology of blindness following the acute anemia of hemorrhage. It is known that after great loss of blood there is a tendency to the development of thrombi, and that the thrombus is apt to occur wherever there happens to be some pressure, some point of resistance to the flow of blood, the disposition to such thrombotic formation being due to diminished pressure of the blood, to alteration in its character, and, probably, also to consequent changes in the vessel-walls. The theory suggested as to the result of my study of a case of blindness following severe hemorrhage from the stomach—in which the ophthalmoscope showed atrophy of the optic nerves and retina, secondary to neuroretinitis—was that the resistance opposed to the enfeebled blood-current by the intra-ocular tension caused the formation of a thrombus in the central artery of the retina, just back of the lamina cribrosa. I am still of the opinion that this theory affords a more satisfactory examination of the intra-ocular changes observed in posthemorrhagic blindness than any other that has been advanced.

DR. WILLIAM M. SWEET, Philadelphia: About ten years ago I reported before the American Ophthalmological Society a case of optic atrophy following intestinal hemorrhage. The man was a healthy driver of a dray, aged 57, who was attacked by vertigo on his way to work. The dizziness and muscular weakness compelled him to return home and go to bed. The same evening he took a large dose of calcined magnesia, and during the night had a large movement of the bowels, which almost filled the two-quart receptacle, and was found the next morning to consist almost entirely of clotted blood. Later in the day there was another bowel movement, almost equal in quantity to the first, but the blood was brighter in color. On the morning of the sixth day, the vision became blurred, and by evening there was loss of perception of light in the left eye, and only light perception in the right eye in a small area to the right of the fixing point. Ophthalmoscopic examination showed the optic disk pale, the nerve margins slightly hazy, the retinal arteries moderately contracted, the retinal veins full but not tortuous, and the retina edematous. From the lower portion of the disk of the right eye a cilioretinal artery passed toward the fovea. Examination of the abdomen failed to show any area of dulness or tenderness to account for the hemorrhages. The blood examination showed hemoglobin, 38 per cent.; red corpuscles, 2,088,000, and white, 20,900. The case was under observation for four years. During this time there was no return of vision in the left eye, and only a slight increase in the size of the preserved field in the right eye, which was about 15 degrees wide and extended temporarily from the fixing point to the 40-degree line on the chart.

Although the result of experimental studies points to degeneration of the retinal ganglion cells, secondary to abnormal changes in the blood acting on the vasomotor system, as the cause of blindness, there would appear to be some other factor in many of the cases. The preservation of a small area in the field in the right eye of the case mentioned may have been due to an anastomosis of the cilioretinal blood-vessel, although the factors which caused the constriction of the central retinal vessel and its branches would apparently have exerted a similar influence on this artery.

DR. ADOLF ALT, St. Louis: The case referred to by Dr. Zentmayer of blindness after hemorrhage is similar to a case now under my care. The patient is a strongly built man, the driver of a brewery wagon. What other diseases he may have had I do not know. He came to the hospital on account of an ulcer of the stomach. While there, lying in bed, he had a severe hemorrhage from the stomach, so severe that he became unconscious for some time. When he awoke he was blind and I was called to examine his eyes. There was an absolute ischemia of both eyes. It was a day or two after the occurrence that I saw him, and with one eye he counted my fingers perhaps at six feet. With the other he saw nothing at all. I have had the man under my observation since. The stomach has been treated by the general practitioner. I have given the patient iron, strychnin, etc. In this case quite an appreciable amount of sight has returned. The eye which was wholly blind counts fingers now at eight feet in a very small central field. The other eye has now 20/20 vision, with correction of the myopia and astigmatism, and without correction has 20/40 in a small field; originally was 10° or 15°, now is between 15° and 20°. He could barely move his legs at first; now he walks about better, but like a man with telescopic vision. I believe the whole thing is simply due to lack of nutrition of the smaller arteries for so many hours and with beginning disintegration of the nerve elements which in this case improved when the blood-pressure became high enough.

I have had another case of atrophy in one eye due to an intranasal operation, the nature of which I have forgotten. The patient bled all through the night and came to me the next day because he was blind on that side. If I remember aright he got better again, but I do not remember exactly what the condition was later on. I saw him only a few times.

DR. WILLIAM ZENTMAYER, Philadelphia: Dr. Theobald, your case occurred in the earlier series so I do not recall its details. Can you tell me whether one or both eyes were affected?

DR. SAMUEL THEOBALD, Baltimore: The matter is nebulous in my mind but my recollection is that only one eye was involved.

DR. WILLIAM ZENTMAYER, Philadelphia: In only about 12 per cent. was there monocular blindness. These are the only cases that can be explained by thrombosis. I think Dr. Alt's case was caused by an embolus carried into the circulation. The same thing occurred in the practice of one of our Philadelphia rhinologists. In this case there was unilateral sudden blindness following an intranasal operation. Dr. Alt's first case was probably one of ischemia of the retina and as in quinin blindness improvement in vision occurred. As we know, quinin blindness is due to ischemia, with resulting degeneration of the retinal ganglion cells. The explanation of the pathogenesis is evident in Dr. Alt's case.

THE PROPER PROVISION FOR TEACHING OPHTHALMOLOGY IN THE MEDICAL SCHOOLS

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Ophthalmology, always a distinct department of medicine, embraced a great mass of clinical facts, as shown in the books of Mackenzie and Desmarres, before the

work of Helmholtz, Graefe and Donders caused its rapid extension in the middle of the nineteenth century. Walton, Lawrence, Bowman, Sichel, Stellwag and other able men had found it an ample field for a life time of study.

The routine use of the ophthalmoscope and the test lenses enormously increased the extent and practical importance of this branch of medicine. It inspired able men of the younger generation with an interest that made it their life work. Jaeger, Arlt, Schweigger, Argyll Robertson are only specimen names from those of the host who, fifty years ago, saw in ophthalmic science the highest development of medical science, and in ophthalmic practice the highest, most exact application of medical art. Williams, Agnew, Noyes and Norris brought the inspiration of the new ophthalmology to America. Hughlings Jackson and Clifford Allbutt took the eye-mirror to throw light on obscure realms of internal medicine. Still active are Hirschberg, Fuchs, Haab, Landolt, Motais, Nettleship, Swanzy, John Green and hundreds of others who have devoted long and busy lives to a science and art that gave ample scope to all their powers. They and their students after them have continued to extend the boundaries of ophthalmic science and art in every direction.

By the labor of these leaders has been developed modern ophthalmology, the proper teaching of which we are to discuss. The catalogue of Hirschberg's collection of its literature occupies 336 octavo pages. The list of books, transactions, monographs and journal articles appearing in the year 1911 takes 151 pages and includes 3,506 titles. They constitute in the aggregate between 20,000 and 30,000 pages. To engage successfully in ophthalmic practice one does not need to read all that has been written about ophthalmology. But the amount of this literature gives some indication, probably the best statistical indication, of the extent to which the problems of ophthalmology have claimed attention and study from those who have gone before us, and are claiming attention and study from those to-day engaged in ophthalmic practice.

Another estimate of what is to be taught in this branch of medicine might be reached by comparing such treatises as those of Weeks, de Schweinitz or Ball with text-books on medicine or surgery, like those of Osler or Tyson, Da Costa or Park, or by comparing the four-volume system of Norris and Oliver or the Graefe-Saemisch "Handbuch" with Allbutt's "Medicine" or Keen's "Surgery." The monographs of ophthalmology still more strikingly illustrate the greatness of this branch of knowledge. From Donders' book on "Accommodation and Refraction of the Eye" to Wood's two-volume "System of Ophthalmic Operations" or Parsons' four-volume "Pathology of the Eye" there is a long line of monographs, the more important of which must be read by any one who would be counted well informed on the literature of ophthalmology.

Consider it from another point of view. The anatomic relations of the ciliary body, lens, iris root and canal of Schlemm are as important to the ophthalmic surgeon as are those of cranial sutures and eminences, and of the cerebral convolutions to him who would do brain surgery. The exact understanding of the relations of the contents of the orbit and the optic nerve to the neighboring sinuses is as important as that of the relations of the fetal head to the pelvic diameters, which claim so much attention from the student of obstetrics. The functions of the visual apparatus are more complex and occupy more space in the text-books of physiology than those of any other special apparatus, except the brain. In diagnosis the ophthalmologist must master special instruments and methods, the trial set, the ophthalmoscope, the perimeter, the transilluminator, the tonometer, the varied muscle tests. These diagnostic attainments cannot be surpassed for refinement and importance in any other branch of medicine. What procedures in surgery require such delicate exactness, more intelligent planning or more carefully elaborated technic than the extraction of cataract, iridectomy or the plastic operations on the lids?

The ophthalmologist, as a rule, knows more of the requirements and attainments of general medicine and surgery than any one outside of ophthalmic practice knows of the attainments and requirements of ophthalmology. In so far as any one class of men are capable of comparing different branches of medical and surgical practice, the members of this Section, by training and experience, are better fitted to compare the requirements for the proper teaching of ophthalmology with those for other departments of medicine and surgery than are any other group of men in the American medical profession. Do any of you believe that there is any line of work carried on in the medical profession which demands more training, or better training, for its proper performance than that encountered in ophthalmic practice? Occasionally there have been surgeons and physicians who have attained proficiency both in general surgery and general medical practice, and in some departments of ophthalmology—such men as Jonathan Hutchinson, Hughlings Jackson, Clifford Allbutt and Sir William Gowers. And these men without exception have given a relatively high place to the diagnostic and operative methods that belong to ophthalmology. That the knowledge and technic of ophthalmic medicine and surgery should be underrated by those who are ignorant of them is not surprising and has no bearing on a just estimate of their relative importance.

Aside from preparation for devotion to ophthalmology as a special line of practice, consider how much there is in it for study that may be of important service to other branches of medicine. The department of ocular hygiene should dominate the lighting of buildings, the conditions for study in schools and for work in factories and offices, and the prevention of blindness by industrial injuries, ophthalmia neonatorum or trachoma. Not less important are the diagnostic services ophthalmology can render in general medicine and surgery, the light it may throw on general diseases, on such processes as arteriosclerosis and lesions within the cranium. These are but scattering suggestions of the extent of the field of ophthalmology, the breadth of the science to be taught, the refinement of the art into which men and women are to be trained.

In our present educational scheme what is the provision made for teaching ophthalmology and its practical application? The best recognition we have been able to secure in the medical curriculum recommended is fifty hours in the scheme of the Council on Medical Education of the American Medical Association, or sixty hours in that of the Association of American Medical Colleges—less than one-third of the two hundred hours that Jaeger is said to have spent in producing a picture of one eye-ground. This period of sixty hours, or less, is intended to cover the only systematic instruction on ophthalmology given in the best American medical colleges.

The text-books of de Schweinitz or Weeks are practically as large as those of Osler or Da Costa. But ophthalmology is to have fifty or sixty hours, and med-

icine or surgery 600 or 800 hours. Are the text-books on medicine or surgery so wonderfully condensed, or those on ophthalmology so padded and stuffed with meaningless sentences, or irrelevant statements, that the subject of the latter can be mastered in one-tenth of the time given to the former? Even obstetrics, which has less literature than ophthalmology, gets three or four times as many hours in the medical curriculum.

It would be interesting to trace how such an anomalous distribution of time in the course ostensibly intended to prepare for every branch of medical practice had come about. But that is another story. The point here is that everybody recognizes that the course on ophthalmology in our best medical schools does not prepare any one for ophthalmic practice. This is recognized by the professor of ophthalmology who says, "I do not undertake to make ophthalmologists of the students." It is recognized by the honest "general" practitioner, who frankly tells his patients, "I do not undertake to treat diseases of the eye."

What is possible in the brief time allotted to ophthalmology? With bright students who have some preliminary training in physics and a good command of the fundamentals of medicine, it is possible to show what a trial case is and the general outlines of its use, so that the man who is interested and earnest will be able to work out presently the cases which the late Dr. Connor has referred to as "simple errors of refraction." It gives opportunity to show the student how he can see into the eye with the ophthalmoscope and to recognize the more striking features of the normal eye-ground and a few of their common variations. He can be given a theoretic knowledge of the taking of the visual fields, can be made acquainted with the more constant symptoms of conjunctivitis and iritis. He can learn that ophthalmia neonatorum and trachoma are dangerous to sight, and for each a routine treatment. He can be told that glaucoma and detachment of the retina, as well as cataract and intra-ocular tumors, cause blindness. But with regard to the mass of diseases of the eye, as noted in the twenty-page classification, published two years ago by Duane, in the *Transactions of the American Ophthalmological Society*, he can know nothing. We may teach him to turn the lid and drop a collyrium into the eye, to remove a displaced lash or a superficial foreign body; but the best that we can hope to do with regard to the removal of cataract, the doing of an iridectomy, the operations for a squint or deformity of the lids is to impress him with their difficulties sufficiently to induce him to study farther before he undertakes them.

The fact is that the medical graduate may go out from the only responsible medical schools, the only schools recognized by our medical licensing boards, with but little more knowledge of optics than the best of the self-trained opticians and with little more skill in ophthalmic operations than the foreman of a machine shop who takes the foreign bodies out of the eyes of his workmen.

How then has ophthalmology been learned by those who wish to prepare themselves for ophthalmic practice? It is learned quite outside of our teaching institutions by those sufficiently interested and fond of study, through the systematic reading of text-books, monographs and ophthalmic journals; through the conscientious observation and consideration of such patients as come under their care; through service in private office or public clinic as assistant of some one more advanced in the line; through residence and service in one of our few ophthalmic hospitals, or through visiting and following, more or less closely, similar work in the medical centers of this country or abroad. In a very large degree the American ophthalmologist of to-day is self-educated. This has its advantages that are appreciable in the individual case; and its fatal disadvantages, as a general method of instruction for a profession on which the community has to depend for important special service.

On the side of advantages we may count the enormous pedagogic gain achieved by letting the student pursue exclusively the line of work in which he is interested. If his time and interest are all absorbed in dealing with errors of refraction, he will reach an expertness in their diagnosis that the well-rounded practitioner might not attain. The same is true with reference to operative ophthalmic surgery or to the refinements of ophthalmoscopic diagnosis. By such a method are developed the extreme refinements of skill in particular branches that mark the work of the best ophthalmologists of our time. But for the purposes of serving the needs of the community this is largely specialism run to the extreme. As a means of securing a general standard of competence it is preposterous.

There is a dark side to the working of this system, or lack of system. With the absence of any authority to lay out and enforce a systematic course in ophthalmology, or to determine when such course has been successfully pursued, the community is at the mercy of the "get-rich-quick" scheme that leads the man, who is making a failure in some other line of practice, to go to a six weeks' proprietary post-graduate institution and then to return to the scene of his former failure, or more often, to make his appearance in some other part of the country as a full-fledged specialist in diseases of the eye, and probably also of the ear, nose and throat. The six weeks, if at all devoted to the effort, furnishes two or three times as many hours as the undergraduate medical school gives to ophthalmology, and will give the would-be-specialist a start which places him at an advantage over the general practitioner of the community in which he settles. Only a few shrewd judges of men will be able to pierce the thin cloak of special knowledge that veils the underlying ignorance. The six weeks' graduate will get patients suffering from diseases of the eye, and will come to be known as an authority in that branch by a good many people in the region. And, although he never opens a new book or learns the name of an ophthalmic journal, his place among ophthalmologists, as well as that of the more conscientious student, is thenceforth established; and the courage that enabled him to strike out into this new unguarded field is abundantly rewarded. Elsewhere I have pointed out some shining examples of this kind of self-made specialist: the professor of ophthalmology in a western medical school, who had seen three cases of "glioma of the retina beginning after 50 years of age"; the ex-president of his state medical society who knew there could be no such thing as mixed astigmatism, because an eye could not be both hyperopic and myopic at the same time; the eminent oculist of a great eastern city who argued that astigmatism might depend on displacement of the retina. Such failures of the old plan for ophthalmic education are striking, but not unique.

Go up higher. Take those who exemplify the best results of this system of ophthalmic education. Is not their preparation for the whole of ophthalmic practice likely to be faulty in some direction? Who is there here that, looking over his qualifications for his work, is not (as I am) conscious that in some direction he might have been, and should have been, better trained? One,

for instance, does not feel sure of the results he gets in measuring refraction; another feels himself at a serious disadvantage when he attempts to work out the significance of some paralysis of the ocular muscles; a third would rather avoid a plastic operation on the lids or orbit, and so through the list. We can each find a good excuse for our deficiencies—no one told us at the important time the need of special study of this or that particular point. Systematic instruction, in pathology or bacteriology, for instance, was not to be had at the time that we could have taken it to the best advantage. Later we have been hindered by this or that important matter from making good the deficiency, although fully conscious of it.

These defects in training, as well as the imposition of the six weeks' specialist on the innocent public and the guileless general practitioner, are all chargeable to the lack of a recognized systematic course of preparation for entrance on ophthalmic practice. One hundred years ago, comparatively few took any course of systematic study before entering the practice of medicine or of law, and schools of dentistry and engineering were quite unknown. Time has demonstrated that the well-conducted school, offering systematic courses and enforcing a rounded curriculum, is by far the best means of preparation for entering the practice of a profession. Only the indisposition to change, the stolid, unthinking position that what has been is right and must continue, stands in the way of the recognition of this truth with reference to the training for ophthalmology. I am convinced from the evidence of the past year that even this attitude no longer offers an insurmountable or very serious obstacle to the proper teaching of ophthalmology.

The absence of any curriculum recognized as properly preparing for the practice of ophthalmology leaves both the medical profession and the public unable to decide what should be expected of a candidate for ophthalmic practice, or as to who has conformed to reasonable requirements of preparation for such work. This is not only a hardship to those who need the services of an ophthalmologist and an opportunity for the impostor; it also greatly limits the use that would be made of such services, lessens the value of our science and art to the community and prevents us from receiving the proper respect and consideration from the public. Our western fruit-growers discovered some years ago that carefully sorting and standardizing the products of their orchards not only paid for the labor expended and gave an increased profit, but also greatly extended the market for that product. If people knew what they could get and from whom they could get it, the number ready to act on such exact information would be greater.

There can be no doubt that much of the growth of the dental service of the community that has occurred in the last fifty years has been due to the perfectly definite professional status of dentists. The optometrists are so conscious of the value of a definite standard of attainment in professional skill that they are spending thousands of dollars in literature, legislative campaigns and newspaper advertising in order to set up the pretense of such a standard regarding one part of ophthalmology, their claim being supported chiefly by ambitious hopes and the fact that thirty-three students are taking the course on optics at Columbia University.

It may be asked, "Is the need of men trained for ophthalmic practice sufficiently great to justify teaching institutions providing the required training?" It will appear on examination that the demand for trained ophthalmologists is greater than has yet been recognized in any formal estimate of the situation. From month to month I receive letters from people in towns of considerable size inquiring where they can get the services of a reliable ophthalmic specialist. Some of these letters are from patients, or members of their families; some are from well-known ophthalmologists with patients still in need of attention going to the places indicated. I probably have as good opportunity for knowing the ophthalmologists of a large part of this country as any one. Yet there are regions of hundreds of miles of fairly populated states in which no such services are to be obtained.

If trained ophthalmologists were sufficiently numerous and properly distributed to be available for all the services they could render to the community, I believe that one to every 10,000 inhabitants would find plenty of work and fair remuneration. Some of you have seen as many as 10,000 patients in private practice, but not all of you, not the majority; that would be a new patient—not the return of an old one—every day for thirty years. Practically all members of the community could be mutually benefited at some time by the services of an expert ophthalmologist, and many require a great deal of such service. Suppose that such 10,000 patients average 25 cents a year, $5.00 in twenty years, as their contribution to the ophthalmologist, the sum would be much above the average income of members of the medical profession. One ophthalmologist to 10,000 inhabitants would mean about 10,000 physicians trained in ophthalmology needed in the United States, and when we remember that of the men having such training we cannot expect an average of over twenty-five years of professional service, it means that there is a need of 400 men trained for ophthalmic practice each year. That the present opportunities for residence in ophthalmic hospitals and as assistants in eye-clinics are inadequate to furnish any such number of trained ophthalmologists is evident.

For the medical schools favorably situated with adequate facilities, there is no line of work that they can take up of more service to the community or of more advantage to themselves than this of systematizing and standardizing the training of ophthalmic practice.

What ground should this training cover? What facilities for study should it offer and utilize? How should the curriculum be arranged?

The course of training for a profession is not to be elaborated in a few hours of thought and compressed into a rounded paragraph, or thrown together in the course of a single discussion. But, above all things, it is desirable that we should arrive at some definite practical suggestions; and, in order to give definiteness to this discussion, this scheme is outlined.

The work done before obtaining the degree of doctor of medicine should include the acquirement of a definite knowledge of the special anatomy and physiology of the eye, and of the general anatomy and physiology of all tissues entering into the composition of the eyeball or accessory parts. Only certain special problems in anatomy and physiology, like those regarding the filtration-space and the maintenance of intra-ocular tension, should be left for study in this special course. General pathology should be mastered in the undergraduate medical course; the processes of inflammation and degeneration, the characteristics and tendencies of tumors should all be familiar to every medical graduate. Moreover such an acquaintance with the ophthalmoscope, the trial lenses and other standard methods of ophthalmic diagnosis, as has been mentioned above, should be possessed by all

graduates in medicine; and graduation in medicine after a standard four years' course should be made a preliminary to the work to be outlined. Furthermore, the special student of ophthalmology should have certain preliminary studies not required of all graduates of medicine. Both in justice to himself and to the community he should have some acquaintance with physical optics, algebra and plane trigonometry.

With such a foundation the special curriculum in ophthalmology may be undertaken with profit. The back-bone of the course should be one year of clinical work in an eye-clinic. This must be chiefly an outpatient service, but will be better to include a certain number of hospital patients. Perhaps an equivalent may be found in serving as an assistant to an ophthalmologist in full practice, the longer hours devoted to the work tending to make up for deficiencies in other directions. With the clinical work should go the careful study of every portion of one of the larger complete treatises on ophthalmology and the reading up of particular subjects in other text-books, monographs or journals in connection with cases encountered in clinical work. In addition, there should be work on pathologic specimens, both gross and microscopic, including the examination of smears and cultures, drill in the more common important operations on the eyes of the lower animals, special instruction regarding the eye symptoms of diseases of the central nervous system and important general diseases. During the whole course the student should be assisted by demonstrations, and his work supervised by means of quizzes and clinical conferences. Finally there should be one or more thorough examinations, written, oral and practical, to test the knowledge the student has acquired and his ability to focus it on the question or case under consideration. To those successfully completing such a course a special degree should be given.

Such a scheme or schedule raises many important questions. First, the time to be devoted to it. A great deal could be said in favor of two or three years devoted to ophthalmology before recognizing the candidate as competent. But there is danger of making the requirements so rigid that not enough will meet them to supply the needs of the community and to establish such a course of study as the only proper entrance to ophthalmic practice. To establish a supervised course of one year is a radical departure from the practice of the past. When it has been thoroughly developed what this will do for the student, improvement in the curriculum may properly be considered. With reference to the preliminary requirements, it would be easy to argue for one year's work as intern in a general hospital. But the process of prolonging student life before entering on actual professional work has been carried about as far as can wisely be done, in view of the limitations imposed by human nature and the need of turning the youthful energy into channels into which it is to flow throughout active life, at the earliest date compatible with fair preparation of the average individual. The need is not now to lengthen the period of study, but to use it to better advantage, more economically, more efficiently; to bring into play more immediately and effectively the life motive, a realization that the individual has actually entered on the labor that is to determine his permanent place in society, and to bring this motive into play at the earliest possible moment.

The requirements regarding mathematics and physical optics might be a subject for discussion. But it would seem that, when so large a part of the work of the ophthalmologist consists of the measurement of the optical conditions of the eye and the correction of refractive errors, this kind of preparation ought to be insisted on, although many who graduate from standard medical schools may not be ready to meet the requirement. To make up such a deficiency will usually not take many weeks, and it furnishes an excellent exercise for one who is entering on the practical study of physiologic optics.

Nothing has been said about the part of the course devoted to the refraction of the eye. In clinical work, in reading, in demonstrations and in quizzing, this should receive the full share of attention. It is so different from most of the undergraduate medical course that the preparation for ophthalmic practice may well include special emphasis on it, without conceding that it constitutes the whole, or almost the whole, of the practice of ophthalmology.

Briefly to recapitulate: Ophthalmology is a field broad enough to claim all the time and energy that can be given to it by any trained mind. Proper preparation for ophthalmic practice requires as long, systematic and thorough training as preparation for any other profession. Such professional training should be systematic and carried on by responsible institutions, working up to a recognized standard.

The supervising and standardizing of the course on ophthalmology will result in the more complete and rounded training of competent ophthalmologists and in the elimination of the incompetents who seek a short cut to professional standing and financial success. It will greatly improve and extend the ophthalmic service of the community.

The systematic supervised course that it is now practicable to establish should be based on completion of the ordinary medical curriculum and acquaintance with the necessary mathematics and physical optics, and should include one year of clinical work in ophthalmology, a careful systematic course of reading, with systematic instruction in special diagnostic methods, ocular pathology and therapeutics, and the measurement and correction of errors of ocular refraction.

Metropolitan Building.

ABSTRACT OF DISCUSSION

DR. SAMUEL D. RISLEY, Philadelphia: I agree with Dr. Jackson; at present undergraduate teaching is inadequate as an equipment for the practice of ophthalmology as a specialty. The same may be said, with less emphasis, it is true, for any branch of medical science. The young graduate physician who has failed to secure an internship in some general hospital for at least one year, or work under the tutelage of a large clinic is not a safe practitioner of any branch of medicine or surgery. Without such opportunity his experience is gained at the expense of the community in which he settles. This is especially true of ophthalmology and otology for which the requirements of the curriculum are relatively meager. In ophthalmology, moreover, a preliminary training in mathematics, more thorough than is usually acquired in the average B.A. degree, is necessary for a definite comprehension of many of the optical problems which present themselves in the dioptric system of the eye.

I have passed most of my professional life in the study and practice of ocular affections which found no mention in my university course of instruction. One of two courses must be adopted, if the evils pointed out by Dr. Jackson are to be remedied, that is to say, if the members of the community are to be spared the danger of submitting themselves to the care of incompetent ophthalmic surgeons: (1) the hours devoted to ophthalmic study in the medical college must be largely extended and supplemented by largely increased facilities for clinical opportunity; or (2) the lead-

ing medical schools and universities must provide postgraduate opportunity for the study of ophthalmology.

To provide adequate equipment for the undergraduate would require an extension of the time now allotted to the medical course. Indeed, the extension of the course in our leading medical schools to five years is now under serious consideration, though it is urged that the young physician will be too far advanced in years before entering on the practice of his profession. If a postgraduate course in ophthalmology is to be required before the student is allowed to employ his ophthalmoscope in practice, at least one additional year must be added to his life as a student.

The leading university medical schools should provide a complete course of didactic study with ample clinical facilities as a postgraduate department for which a degree either of Doctor of Philosophy or of Doctor of Ophthalmology should be awarded. Such provision would in a single generation remove the unfortunate conditions described by Dr. Jackson and lead to a rapid advance in the science of ophthalmology and great benefit to the people.

DR. F. C. TODD, Minneapolis: In the matter of teaching undergraduates we have to bear in mind that we are undertaking the preparation of general practitioners in which we are expected to teach the student, first, those things in ophthalmology which have a relation to, or a bearing on the diseases of a more general character. Thus, for example, he should be taught ophthalmoscopy that he may be able better to make diagnoses. I dare say that to-day in many schools things are being taught in such departments as medicine and neurology that will prove of less value to the practitioner when dealing with his patients and endeavoring to make a diagnosis than would be a sufficient knowledge of ophthalmology which the time now allotted the subject does not permit. Second, if the general practitioner is to serve his community properly, he must learn to treat the common and simple eye diseases which he may safely treat. Third, he must have sufficient knowledge to diagnose properly those diseases which might produce blindness that he may send them to an expert or treat them himself in such a manner as to prevent blindness or, at least, not to cause it by improper treatment. And he must be prepared to do the emergency work that will come his way. He must, for instance, if no expert is at hand, know how to do promptly an iridectomy when a prolapse of the iris has occurred as the result of a penetrating wound of the cornea.

I believe that there are more eyes becoming blind to-day because of the lack of knowledge and training of our general practitioners in ophthalmology than result from ophthalmia neonatorum, since that disease has so decreased in our country.

All this we cannot do in fifty hours and hence we must select the most important part and leave out the rest until such time as the medical course shall have added the fifth clinical year. We cannot, therefore, teach refraction to undergraduates excepting as an optional or elective course. At the University of Minnesota we have adopted a fifth, or clinical year, beginning with the class entered in 1911. This will consist of a year of clinical work in a hospital of recognized standing, during which the work of the student will be under the supervision of the faculty and he will be given out-patient service. During this year we hope to have the opportunity to pick up the loose ends and better finish the incomplete product. This year should serve for the fuller teaching of the things the general practitioner should know concerning ophthalmology and the other specialties.

DR. T. CHALMERS FULTON, Philadelphia: Every man who essays to be an ophthalmologist should first have a reasonable knowledge of general medicine and surgery. I am in favor of having a man practice general medicine and surgery and become an all-around medical man first, but I would advise that man to commence early with the use of the ophthalmoscope because after a certain period of time we cannot educate the muscle of accommodation in the use of the ophthalmoscope. We all know, if we are absent for any length of time from our work, and from the ophthalmoscope, how hard it is to get our ophthalmoscopic legs on again, so to speak. I favor adding a year to the course of training in ophthalmology. During my pupilage at Jefferson, thirty years ago, when the eye clinic was on the boys would disappear. It was entirely too dry. In my judgment the study of ophthalmology is so important that we cannot allow specialists to be created in large numbers unless they are properly qualified. I would be in favor of making a special course as has been outlined by Dr. Jackson, and at the end of that time having the men who aspire to practice ophthalmology pass a special examination by a special board, and after the successful passage of that examination to have a certain degree, say for instance, "O.S.," "Ophthalmic Surgeon," or "Oph.," "Ophthalmologist," or something of that kind. Every pedler around the corner is selling "specks." We must fight the optometrists and the optometry courses in the schools. Thirty-three in the class at Columbia University! Think of it!

DR. EDWARD JACKSON, Denver: The question of lengthening the period of student life is a very serious one. In the National Educational Association a committee has been for some years working on the problem of the reorganization of secondary education with the idea of getting students into college earlier, and condensing the ordinary college course. The plan has been adopted, first in the University of Michigan and afterward in some of the other universities, of requiring a six years' course to cover the work both for the A.B. and for the M.D. degrees, principally by recognizing that a large part of the medical course may have a cultural value that should entitle the student to recognition as a scholar for the bachelor's degree.

If the student enters college at 17 and pursues there a six years' course, he will take his degree at 23; and then adding a year of work in ophthalmology he will be ready for active work at the age of 24, and that probably is pretty nearly the average age at which a student should enter into practice. Much could be said for thorough training in other branches of medicine to fit us for the practice of ophthalmology. But the public deserves the benefit of the special knowledge which the oculist is supposed to possess, which is his particular *raison d'être*. The thing that has been greatly neglected up to the present time, the training in ophthalmology itself, needs to be greatly emphasized now.

I think the situation is far from being as hopeless as Dr. Risley seems to believe. The course in ophthalmology in Oxford University has in a way been successful, although conditions there are not favorable to success, on account of the situation and traditions of Oxford. The University of Liverpool, a younger but important technical institution, is giving a similar course.

In this country the University of Colorado has undertaken to give such a course, based on a year of clinical work and the necessary teaching, to give the degree of doctor of ophthalmology. This is the degree that is given at Oxford. Probably within three years two or three other of our best universities and medical schools will have established similar courses. From the very wide-spread interest that has been expressed I am certain that the time has come for such a move, and it will be supported. We can all have some influence by expressing our approval in the medical profession and in medical meetings. In the House of Delegates a member who did not know what action was taken last year introduced resolutions demanding a two years' course in ophthalmology.

CATARACT EXTRACTION WITH CORNEAL SUTURE

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From time to time ophthalmic surgeons have tried to find some satisfactory means of closing the corneal wound after cataract extraction by mechanical means. Briefly, the means used have been some sort of sliding conjunc-

tival flap, or direct suture of the wound, and it is with the latter alone that this paper will deal. The sutures have been applied either to the conjunctiva or the cornea.

The first published description of such attempts is that of H. W. Williams[1] of Boston, who placed sutures through and through the lips of the corneal wound after extraction of cataract, and reported favorable results. He later modified this to the extent of placing the suture in the conjunctiva only. We occasionally hear yet of similar efforts, but as this method is resorted to after the completion of the operation, it has seemed objectionable, in that if a cataract extraction has been completed successfully most surgeons are willing to omit any finishing touches, especially as a well-made conjunctival flap quickly smooths itself out and adheres to the sclera without other assistance than the pressure of the lid. If the operation has not been satisfactorily accomplished, and especially if there has been loss of vitreous, the surgeon is even more anxious to close the eye without the addition of any manipulation that can be omitted. For this, or other reasons, suture of the conjunctival flap has never been popular. The first attempts at corneal suture, also accomplished after completion of the extraction, were open to the same objections.

Probably with the idea of avoiding these objections, Suarez de Mendoza[2] devised a plan of introducing a suture into the cornea before making the corneal suture, and in 1889 and 1891 published reports of thirty-eight operations performed in this manner. He made a shallow incision into the surface of the cornea about where the incision for the extraction of the cataract would fall, and then passed the suture through the lips of this groove, the loop of the suture being drawn well out to escape being cut. The incision was then made to face in this shallow groove. After the extraction the suture was tied. It will be seen that this suture did not penetrate the cornea, but was passed into it only, and was not open to the objections that would apply to a through and through suture.

The most noteworthy work by far with the corneal suture as a step in cataract extraction is that of Professor Kalt[3] of Paris. His publications on the subject consist of two papers, dated 1894 and 1910. In the first one the results in fifty cases are given, while the second paper gives 2,000. It is with this method that this paper has to do.

In common with others I knew vaguely of the Kalt operation, but I was, also in common with others, not especially impressed with its advantages, while I was very much impressed with the desire to make the operation as simple as possible, and to omit all apparently unnecessary detail. In the summer of 1910 it was my privilege to see Professor Kalt's work, and the skill of this operator made the procedure seem so easy that I was tempted to try it, with the results that will be related. While the experience about to be related is very limited, still one learns something from even a limited experience, and this experience may be of interest inasmuch as not very many have apparently given the method a trial.

A good idea of the procedure itself and its philosophy is to be gained from Kalt's last paper, from which the following extract is taken:

1. Williams, H. W.: Roy. Lond. Ophth. Hosp. Rep. 1867, vi, Part 1; Cataract Extraction Operations, Arch. of Ophthalmology and Otology, 1869, i, 102.
2. Ferdinand Suarez de Mendoza: Bull. et mém Soc. d'ophtal., Dec. 4, 1888; Rec. de ophthal., 1889, pp. 47, 523, 544; Rec. d'ophthal., 1891, p. 597.
3. Kalt, E.: Arch. Ophth., 1894, xxiii, 421; Ann. d'ocul., June, 1910.

PLACING THE SUTURE

The suture consists of a vertical corneal portion and a transverse episcleral portion. The whole forms a T, with a gap between the junction of the horizontal portion with the vertical portion. The length of each of these portions does not exceed 1 mm. The vertical intracorneal branch follows the vertical corneal meridian and stops exactly at the juncture of the transparent portion with the sclera. The horizontal portion traverses the opaque part of the limbus as near the cornea as possible. An interval of 0.5 mm., corresponding to the limbus, is ample to permit the passage of the knife.

Not to quote verbatim the rest of the paper, it is stated that in passing the suture the corneal portion (vertical) is passed first. The loop of the suture is left long and laid to one side, and if wet will adhere to the skin, or to the gauze with which the skin is covered, and not get tangled. In passing the knife, the incision may be completed in an oblique meridian of the cornea instead of the vertical, thus rendering the cutting of the thread less likely. The corneal incision, capsulotomy and delivery of the lens being completed, the thread is drawn by pulling on its upper (scleral) branch, and a square knot is tied. If this suture is well placed, and the points are close to each other, tying does not cause much folding of the cornea, but it is of no matter if it does, as the postoperative astigmatism is not affected thereby. Prolapse of iris and vitreous, if they occur, are reduced by tying the suture and thus approximating the corneal wound. "The knot once tied, one is master of the situation." Cortical masses are removed with a suction aspirator, and the iris smoothed into place without fear of provoking loss of vitreous. Physostigmin (eserin) may be used when the iris tends to prolapse, but is not as a rule. The dressing is monocular, and patients get up on the second day. The stitch is removed on the second or third day, usually the latter.

To consider the proposition in some detail, a discussion of the following points will cover the ground.

I. The introduction and removal of the stitch.
II. Accidents.
III. The control of iris and vitreous prolapse by the stitch.
IV. The toilet of the wound.
V. Secondary iris prolapse after corneal suture.
VI. The course of healing.
VII. Results.

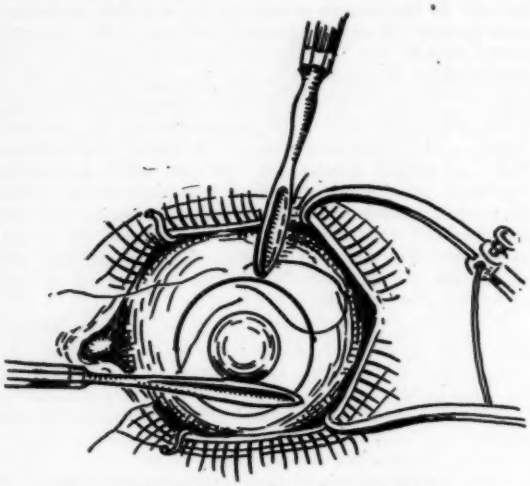
I. THE INTRODUCTION AND REMOVAL OF THE STITCH

Nearly every one who has written concerning the corneal suture speaks of the difficulty of introducing it, that it adds a step to the operation, and that its removal is a second operation. Thus Van Lint[4] says that it is "an operation which is difficult of execution," and others say the same thing. Fully conscious of my own limitations as regards operative skill, I can state that any one who is qualified to do ophthalmic surgery at all need not be deterred from trying this procedure on account of the difficulties of carrying it out. The proper materials must be used, but with them the corneal suture is surprisingly easy. The proper needle and thread must be employed, however, and here it might be said that the suggestion to employ an absorbable suture is based on theoretical reasons only, as the finest catgut obtainable will not pass through the eye of the right sort of needle. While Kalt advises cotton, the suture material which may be obtained from Luer is silk, and is perfectly satisfactory.

4. Van Lint: Clin. Ophth., iii, No. 7.

It is not necessary to tell the patient that his eye is being sewed up. While it may be the operator's five hundredth extraction, the patient has had no such extensive experience, and does not readily detect slight variations from the usual technic. So when the time comes for its removal, the eye can be cocainized and the patient then told that there is a thread to come out, the lid raised and the suture cut and removed in less time than it takes to tell of it. Accustomed as he is to hear of wounds being sewed, it will seem most natural to the patient that this wound has been treated in that manner. Many people dread the removal of stitches more than they do an operation, and it is well not to alarm them by telling them that there is a stitch in the eye that must come out on such and such a day. All this seems a trivial matter to discuss before a scientific body, but it is the answer to the objection that removal of the stitch is a second operation. At least it is not so unless the operator chooses to make it so.

In tying the stitch there is an advantage in producing a slight wrinkling of the cornea, as by this means one can be sure that good apposition is secured. Not only is



Corneal suture introduced but not tied.

this wrinkling temporary, but it even passes off under the pressure of the aqueous when the anterior chamber reforms. A loosely tied stitch, such as some have practiced, is of no advantage at all, as without some tension on the edges of the wound, they only lie in apposition just as they would do without any stitch.

The stitch should be removed as soon as the corneal wound is well adhered, which can safely be considered as about twenty-four hours after the anterior chamber is reformed. This gives a good margin, and will be as a rule on the third day. Stitches are foreign bodies and should be removed from every tissue at the earliest possible moment, not only in eye surgery, but elsewhere. To permit them to remain is to invite irritation and infection, neither of which seem to occur when the stitch is removed as soon as Kalt advises.

II. ACCIDENTS

The only accidents likely to happen, besides the ones common to all cataract extractions, are cutting the stitch in making the corneal incision and tearing out the stitch in removing the speculum. Kalt cuts the stitch in 1 per cent. of cases, and in the series of cases herewith presented it was cut twice. It can be replaced by passing the needle through the same hole, which is easier to do than it sounds, and is what Kalt advises.

If the thread is not kept carefully laid out the loop may catch in the speculum and be torn out in removing that instrument, as occurred in one of my cases. It must be understood that this can occur only when the speculum is removed before the suture is tied. If the patient does not tend to squeeze and there is no threatening vitreous prolapse, the speculum is left in until the lens is removed and the thread tied and cut off. In the event of this accident it is best to pull out the other branch of the stitch and complete the operation without it. Both of these accidents can be avoided if the whole procedure is carefully conducted.

III. CONTROL OF IRIS AND VITREOUS PROLAPSE

A signal advantage of the stitch is in cases of prolapse of iris and vitreous, especially the latter, at the time of operation. The usual precautions of removal of the speculum and control of the lids by other methods are to be followed, but nevertheless sometimes a large vitreous bead will protrude from the wound. No one who has ever seen this gently retire into the ball as the stitch is tightened will need any other argument to convince him of the value of the stitch, at least under these circumstances. As it cannot be foretold when this accident will happen it is well to be prepared for it in every case.

The control of primary iris prolapse is not so satisfactory, but certainly the replaced iris is more apt to stay replaced when the corneal wound is closed by mechanical means. In this operation the fact that the incision is in corneal tissue and well in front of the plane of the iris makes prolapse of the iris less likely to occur than when the incision is further back, as in the ordinary section with the conjunctival flap.

IV. THE TOILET OF THE WOUND

A great advantage of the corneal stitch is in the facility it affords to the making of a deliberate, careful and thorough toilet of the wound. After the delivery of the lens and tying of the stitch, we can, by irrigation, suction and manipulation, get a perfectly clear pupil—clearer than by any other means. Without the stitch one hesitates to do much in this direction if there has been vitreous prolapse, and if there has not been, the manipulations of the toilet often provoke a tendency to "squeeze" which results in prolapse. Certainly nothing contributes so much to a speedy and uneventful healing as removal of cortical flakes and tags of capsule, and their retention within the eye leads to prolonged convalescence and irritation, if not destructive plastic inflammation.

As was mentioned, the suction apparatus is the means usually employed by Kalt, but irrigation is also very safe and satisfactory. The tip of the irrigator is introduced into the anterior chamber at one side of the stitch, while a spatula depresses the scleral lip of the wound on the other side of the stitch, to afford a free outflow of the irrigating fluid and the cortical matter and blood which it expels. It might be noted incidentally that the possibility of this thorough toilet makes the removal of immature cataract a much more satisfactory procedure than when it is extracted in the ordinary way.

V. SECONDARY IRIS PROLAPSE

The stitch is not a sure protection against secondary prolapse. Kalt has observed it in 3 per cent. of the last 1,100 cases which he reports, while the percentage in this series of cases is much higher, namely, 9⅓ per cent., owing, presumably, in part at least, to lack of skill.

After an ordinary simple extraction prolapse of iris is the most frequent complication, and occurs in about 10 per cent. to 12 per cent. of cases. When it does occur it tends to rapidly assume large proportions, and its removal is a more formidable procedure in many cases than the extraction of the cataract. The iris quickly adheres to the lips of the wound, and iridectomy under these circumstances is far from easy, and the result is not satisfactory to our esthetic sense. Rarely does one see under these circumstances a clear coloboma, with pillars straight and not entangled in the corneal wound. Without offering an explanation of the difference, it can only be said that the prolapse after suture of the cornea is not only small—limited to one side of the stitch—but does not tend to inflame and quickly adhere to the wound. Its removal, therefore, is easy, and the pillars dress back nicely into the eye, leaving the wound free. One may not understand the reason of this difference, but from my experience such is the case. One of the patients referred to in this paper struck his eye a week after extraction, separated the wound slightly and had an adhesion of the iris to the wound. This was not a prolapse into the wound, and at any rate was not attributable to the method of operation.

The number of cases of iris prolapse in this series is large, namely, 9⅓ per cent., and greater familiarity with the operation would probably reduce that. To offset this, Cases 2 and 7 should be noted. In Case 2, the conduct of the patient was such as to justify the removal of the speculum after completion of the corneal incision. She promptly squeezed the lids together catching the corneal flap with the upper lid and turning it down. After securing the lid with an elevator the lens was delivered and the stitch tied. Deliberate toilet of the wound was then made without fear of accident, and the final result was perfect. In Case 7, the patient had violent uremic convulsions the night of the operation. Next morning the nurse had prepared, without instruction, the instruments for excision of an iris prolapse, it being inconceivable how prolapse could fail to be present. To the surprise of all the wound was closed and the iris in place and a round central pupil resulted. Certainly without mechanical closure of the wound one would dread the result in the case of such an accident as happened to this patient.

VI. COURSE OF HEALING

The course of healing after operation with corneal suture does not differ materially from that after other methods of extraction. Infection, iridocyclitis and other complications are possible, but it can only be said that in this series they did not occur. The stitch does not seem to cause any irritation; that is, there is no complaint as of a foreign body, such as one might expect. There is certainly no more redness or secretion than after the operation without corneal suture.

It has been said that the stitch would be apt to become infected, but in this series of cases it did not occur. Cleanliness in every detail in the operation and early removal of the stitch are the best safeguards against infection or post-operative reaction. The freedom from cortical débris, more easily secured by this method than by others, in my experience, favors a quick and uneventful convalescence. In cases in which this is true, secondary cataract is of course not frequent, and equally as a matter of course, this follows, no matter what method of extraction is employed.

VII. RESULTS

In speaking of results, the visual result need not be considered, since no one would expect that better visual results will follow a successful extraction by one method than those obtained by another. Nor does it seem to be the rule that better visual results follow the simple extraction than those obtained by the combined method. The surgical results are very good in operations in which the corneal suture is used; better, I think, in a large number of cases than by other methods. There is a speedier convalescence, the pupil is clearer, and there is therefore less tendency to secondary cataract; the early closing of the wound permits the patient to get out of bed sooner and have the eye not operated on left uncovered, and the early closure of the wound is also a safeguard, although but relative, against infection.

Every workman has pride in the results of his work, and from the cosmetic point of view the simple extraction is a more satisfactory thing to him than the combined. The patient, however, is seeking vision, not cosmetic results, and any method to stand the test must be the one to give the largest percentage of functionating eyes in a large number of cases. Unless it fulfils this requirement, it is of no moment to exhibit a few *de luxe* results.

REPORT OF CASES

CASES 1 and 2.—F. M. (colored), aged 65. Cataract in both eyes. March 15, 1911: Right eye: Simple extraction. Corneal stitch. March 16, 1911: Wound closed. March 18, 1911: Stitch removed. Left eye: March 30, 1911: Simple extraction. Corneal stitch. Incision On removal of speculum patient squeezed lids, closed the eye and flap was turned over. Lid elevator, lens removed and stitch tied. Toilet of wound was then performed getting the iris back and a clear black round pupil. April 1, 1911: Stitch removed. Both eyes show round clear pupils. Atropin.

CASE 3.—Mrs. M. F. H., aged 66. March 13, 1911: Right eye: Simple extraction. Corneal stitch. Irrigated. March 14, 1911: Wound closed. March 15, 1911: Stitch removed. Atropin. March 28, 1911: Vision 20/70 with correction. April 13, 1911: Needled. July 5, 1911: Vision 20/40.

CASE 4.—W. M. W., aged 57. April 25, 1911: Simple extraction. Corneal stitch. April 27, 1911: Wound closed. Atropin. April 28, 1911: Stitch removed. April 29, 1911: Wound reopened; anterior chamber empty. April 30, 1911: Same. May 7, 1911: Wound closed, very little redness. Pupil central and slightly irregular. Atropin. Left hospital. Left eye: May 24, 1911: Vision 20/30. Nov. 5, 1911: Vision 20/20. Central movable pupil.

CASE 5.—B. B., aged 51. Left eye: Always squinted and the vision was very poor. Mature black cataract. Convergent squint. Right eye: Immature cataract. Vision 2/200. Good reflex around a central opacity. General condition not very good. Urine contains pus and staphylococci. Blood-pressure 155. Dec. 8, 1911: Simple extraction with corneal stitch. Irrigated. Dec. 9, 1911: Wound closed. Atropin. Dec. 10, 1911: Stitch removed. No cortical matter in pupil. Jan. 16, 1912: Vision 20/40 and J III with glasses.

CASE 6.—Mrs. J. R. W., aged 53. Right eye: Dec. 9, 1911: Corneal stitch. Simple extraction. Dec. 10, 1911: Wound closed. Dec. 11, 1911: Stitch removed. Pupil round, clear and central.

CASE 7.—Mrs. W. S. N., aged 60. June 3, 1911, 8:30 a. m.: Urine contains albumin. Right eye: Simple extraction. Corneal stitch. Suction. 4:30 p. m.: Wound closed. Epigastric pain. 8:30 p. m.: Patient got out of bed, had a convulsion, lost consciousness, and was not conscious for rest of the night. June 4, 1911: Wound closed. Eye normal. Atropin. June 5, 1911: Stitch removed. July 5, 1911: Vision 20/30 with glasses. Central movable pupil.

CASES 8 and 9.—J. J. (colored), aged 60. Left eye: Simple extraction. Corneal stitch. Suction. June 30, 1911: Wound closed. Atropin. July 2, 1911: Stitch removed. Right eye:

July 3, 1911: Simple extraction. Corneal stitch. July 5, 1911: Stitch removed. Both eyes show round, clear, central pupils.

CASE 10.—J. R. (colored), aged 26. Right eye: Trauma twelve days old. Considerable inflammation. Lens dislocated, 1/5 width of pupil, internally shows fundus reflex. Operation under ether on June 27, 1911. Corneal stitch. Incision, loss of vitreous and in removing speculum stitch torn out of cornea. Lens extraction with loop. Iridectomy. June 29, 1911: Wound closed.

CASE 11.—B. R. (colored), aged 70. Left eye: June 9, 1911: Corneal stitch. Simple extraction. Hypermature cataract. Suction. June 11, 1911: Stitch removed. Pupil round. Atropin. July 7, 1911: Vision 20/70 with correction.

CASE 12.—L. Y. (colored), aged 50. Oct. 27, 1911: Iris tremulous. Cataract. Corneal stitch. Squeezed lids, removed speculum and used lid elevator. Incision. Simple extraction. Lens in capsule, bead of vitreous presented and was pushed back by tying stitch. Toilet. Oct. 28, 1911: Wound closed. Oct. 29, 1911: Stitch removed. Pupil somewhat displaced upward.

CASES 13 and 14.—A. M. (colored). Right eye: October, 1910: Simple extraction. Corneal stitch. Slight adhesion of iris to capsule up. Good result. Left eye: Oct. 23, 1911: Corneal stitch. Simple extraction. Squeezed but stitch tied immediately. Toilet. Oct. 26, 1911: Stitch removed. Pupil round and black.

CASE 15.—J. C., aged 32. Right eye: Nov. 22, 1911: Tremulous iris. Corneal stitch was attempted, but needle broke in passing through cornea. Incision. Capsulotomy. Lens fluid and milky. Suction. Nov. 23, 1911: Wound not closed. With closed lids the right eye looks like an empty socket. Much smaller than the left eye. Nov. 25, 1911: Wound closed. Ball full. External appearances normal.

CASE 16.—J. H. (colored), aged 66. Left eye: Jan. 25, 1912: Corneal stitch. Suction after simple extraction. Jan. 26, 1912: Anterior chamber reformed. Atropin. Jan. 27, 1912: Stitch removed. Jan. 30, 1912: Small prolapse of iris into wound at site of corneal stitch. Whole coloboma and pupil occluded by mass of cortical. Patient says he struck his eye night before. Feb. 12, 1912: Vision 20/40.

CASE 17.—S. R., aged 22. Right eye: Dec. 31, 1910: Corneal stitch. Simple extraction. Lens soft. Suction. Jan. 1, 1911: Wound closed. Jan. 2, 1911: Stitch removed. Sept. 16, 1911: Vitreous opacities. Pupil round and central. Vision 5/200.

CASE 18.—B. W., aged 76. Right eye: Feb. 10, 1911: Corneal stitch. Simple extraction. Irrigation. Feb. 11, 1911: Prolapse of iris to temporal side of stitch. Patient had been very restless. Excised prolapse. That afternoon wound closed. Feb. 12, 1911: Stitch removed. Wound clear of iris. Narrow coloboma up and out. Pillars free.

CASE 19.—J. W. B., aged 73. Left eye: Jan. 3, 1911: Corneal stitch. Simple extraction. Irrigation. No trouble. Jan. 4, 1911: Iris prolapse in. Replaced but came out, so excised. Patient is restless, sneezes frequently and sits up. Jan. 5, 1911: Stitch removed. March 11, 1911: Vision 20/25 with glasses. Narrow oblique coloboma. Pillars free.

CASE 20.—L. H. (colored), aged 46. Right eye: Feb. 1, 1911: Corneal stitch. Simple extraction. Feb. 3, 1911: Stitch removed. Good result.

CASE 21.—J. W. P., aged 69. Right eye: May 31, 1911: Corneal stitch. Simple extraction. Suction. June 1, 1911: Prolapse iris up and in. Excised. Smoothed pillars back. June 2, 1911: Stitch removed. June 23, 1911: Vision 20/30 with glasses. Narrow oblique coloboma. Pillars free.

CASE 22—N. G. (colored), aged 70. Right eye: Jan. 29, 1912: Corneal stitch. Eyes deep set. Unruly patient and moved at time of finishing incision. Stitch cut at emergence from cornea. Iridectomy. Capsule forceps and delivery of lens. Jan. 30, 1912: Wound closed.

CASE 23.—J. H. (colored), aged 70. Right eye: Feb. 10, 1912: Corneal stitch. Simple extraction. Suction. Feb. 11, 1912: Wound closed. Feb. 12, 1912: Stitch removed. March 1. 1912: Good surgical result.

CASE 24.—P. P. (colored), aged 65. Left eye: Feb. 13, 1912: Corneal stitch. Simple extraction. Feb. 14, 1912: Wound closed. Feb. 15, 1912: Stitch out. A perfect result. March 13, 1912: Capsulotomy. March 15, 1912: Vision 20/60.

CASE 25.—Miss S. Right eye: Immature cataract. Extraction with corneal stitch. Feb. 29, 1912: Irrigation. March 1, 1912: Wound closed. March 2, 1912: Stitch removed. No cortical in pupil. Minimum reaction. March 10, 1912: Perfect result.

CASE 26.—J. B., aged 70. Jan. 13, 1912: Simple extraction with corneal stitch. Irrigated. Jan. 15, 1912: Stitch removed. Feb. 6, 1912: Round central pupil. Vision 20/20 with glasses.

CASE 27.—W. H. L., aged 62. March 11, 1912: Simple extraction with corneal stitch. Rupture of suspensory ligament and escape of vitreous before delivery of lens. Lens removed with loop. Stitch tied, controlling vitreous. March 13, 1912: Stitch removed. March 14, 1912: A small vitreous bead in wound. March 15, 1912: The vitreous bead has receded. Wound smooth.

CASE 28.—J. H., aged 50. Traumatic luxation of lens into anterior chamber of eighteen months' duration. Painful one month. Oct. 16, 1911: Extraction under ether, with corneal stitch. Vitreous prolapse on completion of incision. Stitch cut by knife, but reinserted. Lens removed with loop. Tying stitch reduced vitreous prolapse. Iris folded upward and could not be smoothed out. Oct. 17, 1911: Wound closed. Oct. 18, 1911: Stitch removed. Good result, pupil displaced upward, as if an iridectomy had been done.

CASES 29, 30, 31 and 32.—Hospital patients whose records were lost. They were all successful simple extractions from a surgical point of view.

Exchange Building.

ABSTRACT OF DISCUSSION

DR. MARK D. STEVENSON, Akron, Ohio: I have had experience with this method of suturing in only five cases. Large sections of the cornea at the corneoscleral margin, if possible, are desirable in order to have easy delivery of the lens or of large cortical masses with the slightest possible amount of pressure, manipulation or bruising of the tissues. The earliest possible closure is always to be desired. A free, unhealed cut may give opportunity for infection, prolapse of vitreous or iris, slow filling of the anterior chamber with sunken cornea and delayed healing with possible chance for the lid to catch into the wound.

I have not employed the suture in the exact fashion described by Kalt, with a vertical corneal and horizontal scleral anchorage, but have made both suture canals horizontal, parallel and about 2 mm. apart. This gives plenty of leeway for the section, which I try to make nearest the corneal suture, so that a slight lip of conjunctiva, especially to the side if the section is completed to one side in an oblique meridian, may lie over the section. With the T-shaped suture canals of Kalt the threads will form a roughly triangular shape when tied, two separate threads a little apart crossing the corneal section. When the suture canals are parallel these threads will form a quadrangle, the vertical parts crossing the section parallel and the same distance apart as the suture canals are in length. A suture canal will hold much more when the thread pulls sidewise than when it pulls on its necessarily most superficial ends, as it does in the Kalt vertical section. I do not see the need of very tight suturing. The thread is delicate and might break; of course a loose suture would be of little or no benefit but a snug suture, even with my canals 2 mm. apart, pulls the episcleral tissue down toward the cornea and makes the opening of the cornea practically impossible while the suture holds. The cut edges of the wound are pulled against each other with no tendency to overlapping. I have not found it difficult to insert or to remove the suture and have carried out Dr. Ellett's advice about not acquainting the patient with its presence until at the time of or after its removal. Especially in old patients, it is often important to have them sitting up as early as possible. They secure better and more comfortable evacuations of the bladder and bowels,

are less nervous and not so depressed and apprehensive as when kept quiet in bed for some time after the operation, which latter I think every cataract patient without a suture or a good conjunctival flap should be.

DR. C. H. WILLIAMS, Boston: It was my good fortune in years gone by to assist my father, H. W. Williams, in a number of cataract operations in which he used the suture in the cornea. He preferred the corneal section known as the Le Brun section, which was made entirely in the cornea, upward, the apex of the cut being just above the edge of the moderately dilated pupil, giving a large corneal wound. The suture was placed at the apex of the cut. The success of the operation depended very largely on the needle used. The needle was flat with an extremely sharp point and a cutting edge one-fourth of the length of the needle, as sharp as a cataract knife. The needle was ¼ inch long and an ordinary forceps with straight points about ⅛ inch wide, strong and roughened on the surface, was used for the needle holder. There was no catch and no jump when the forceps released the needle. The suture was a single strand of the finest sewing silk. The ideal position of the suture was to pass the needle through the apex of the lower corneal flap, going in through the corneal epithelium a little more than 1 mm. from the edge of the cut surface and bringing it out on the cut surface before reaching the membrane of Descemet. The needle was again entered in the upper flap just outside the membrane of Descemet and brought out on the corneal surface, and the ends tied. The suture caused very little irritation. It was removed generally on the third day and kept the edges of the corneal wound in apposition until the process of healing had glued them together. The wound being entirely in the cornea, and not near the plane of the iris, there was very little trouble from iris prolapse. He generally avoided attempts to remove the last particles of cortical substance. The results he got were generally very satisfactory. We have with us to-day Dr. Post whose father had an extraction of this sort done on both eyes years ago and he can tell you something of the operation, the healing and the question of irritation from the stitch. The first cases reported were in 1867 when there was no cocain anesthesia. A number of operations were done under ether, but a number were also done without any anesthetic. The insertion of this suture was not easy. It required very delicate handling, and for that reason was never generally adopted. I do not remember my father's using the conjunctival suture. I do not think he used the corneal suture in the later years of his life, but he did use it during most of his active practice. When the operation of extraction with iridectomy was the generally adopted method he preferred to keep on with the simple extraction, which, under his hands, had given such good results. I afterward used the conjunctival suture.

DR. M. H. POST, St. Louis: Historically I think the operation referred to on my father occurred in 1864. The operation was done without an anesthetic and with no iridectomy, and was done at different times on both eyes. The result was ideal, with perfectly mobile pupils and with vision normal. The operation was done when he was about 55 years old. He lived to be 76 years old. After the operations which had to be done in connection with the first operation, a needling, the eyes were never subjected to anything but the fitting of glasses, and up to the time of his death he read with perfect ease, comfort, and with very great accuracy. At the time of the operation he was confined to bed and as I recollect, his hands were confined. He said the pain of the operation was nothing compared with the pain of confinement to his back with his hands tied down.

DR. WILLIAM H. BATES, New York: I read of this suture in the publications of Dr. Williams and Dr. Kalt and it looked very promising to me. So I went to Dr. Prudden of the College of Physicians and Surgeons, and in his pathologic laboratory did some experimental work for five years on the rabbit. It is very difficult to remove the lens from a rabbit. In the first place the cornea is about one-eighth of the thickness of the human cornea. The lens of the rabbit is very much larger than that of the human eye, the anterior chamber is deep and the operation is altogether very difficult, and during the healing afterward ordinarily one obtains a tremendous amount of reaction and a very dense secondary cataract.

I found very soon that I would need more than one suture, generally five or six, or sometimes more, but I was able to produce a water-tight closure of the wound and then by restoring the anterior chamber with normal salt solution in favorable cases I was able to obtain at the time of operation a clear, round, dilated pupil, and the healing followed without the formation of much if any secondary cataract. In some of my rabbits examined under the microscope there was no secondary cataract. After this work it seemed to me that if this suture was so necessary and yielded such wonderful results in the rabbit, in the human eye it would be equally advantageous, and I read a paper before the Ophthalmologic Section of the Academy of Medicine, recommending that this suture be used as was advised by Kalt and Dr. Williams before him. I had a talk with Dr. Herman Knapp and he told me that Schweiger had tried it in some thirty cases, a report of which was published in the *Archives of Ophthalmology*, but he had abandoned it. He said, "Why would you use it in the human eye when we get such good results with the old-fashioned operation, and the suture does not offer any advantages? It complicates the operation."

I tried it on the human eye and I must confess that I have abandoned its use, and believe that it is generally unnecessary.

DR. E. C. ELLETT, Memphis, Tenn.: I purposely omitted any reference to the conjunctival suture as I did not think that exactly bore on this matter. In one of the two papers of Dr. Williams' father I am positive he says, "I have lately been in the habit of extending this incision to include a conjunctival flap, and place the suture in its apex." But, of course, how much that was his practice or for how long he employed it I have no way of knowing. I would like to acknowledge my indebtedness to Dr. Bates' paper, to which he has referred, for a good deal of the information as to what had been done on this subject. If I remember rightly, Dr. Bates was under the impression that this in and out suture would not answer, because instead of producing apposition of the edges of the wound it would turn them in, and he advocated a through and through suture; but that probably was due to the difference in the thickness of the rabbit's and the human cornea, and the thinner cornea might readily be turned in that way, but I do not think that is apt to occur with the human cornea.

PREPARATORY CAPSULOTOMY IN EXTRACTION OF IMMATURE SENILE CATARACT

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Except to those who are prepared to extract any and every cataractous lens in its capsule, the retention of gelatinous cortex and the presence of portions of the anterior capsule blocking the pupillary area are matters of serious concern, and any procedure which will cause that loosening or complete separation of the capsule from the underlying capsule which accompanies clinical maturity must be greeted as a marked benefit and advance in method. The ripening operations which were in vogue some years ago do not seem to have remained in favor. Massage of the lens is carried out, it is true, by some operators where preliminary iridectomy is performed, but the results do not indicate any very decided, uniform or reliable effect. The only mechanically effectual procedure, that of MacKeown,

consisted in injecting fluid directly under the lens capsule and was, obviously, too dangerous to gain popularity. None of the other methods was reliable and all were slow, if effectual at all. In June, 1911, my attention was attracted by Dr. Homer Smith's essay, to which the Lucien Howe prize had been awarded, in which capsulotomy was advocated as a means of rapidly maturing senile cataract and facilitating its immediate extraction. I was not able to test this procedure for some time, but my first experience was so favorable that I determined to apply it more frequently.

It has seemed to me worth while to give a brief survey of earlier publications on this and similar procedures and to have an exchange of views on the merits of this method and on the results obtained by various operators. I am convinced that it is of the greatest value and, although my experience is very limited, the procedure seems to me to solve an operative problem which is not without its social and economic bearings.

Von Graefe and Mannhardt[1] advised puncture of the anterior capsule three to ten days before extraction in immature cataracts, for the purpose of causing complete opacification of the still transparent clear cortical masses in unripe cataract. This operation was reintroduced by Correnti,[2] in 1872, in a paper which speaks of the procedure as "opening of the anterior capsule preparatory to the extraction of cataract."

"Primary capsule rupture" is the name by which Drake-Brockman[3] designated this method of operation in a series of case reports.

The initial step of the operation is a division of the lens capsule by a stop-needle, the pupil having been previously fully dilated by atropin. This plan he adopted at first in the case of Morgagnian cataracts in order to gain a more exact knowledge of the size of the nucleus, and accordingly to limit the section through the cornea. The risks attending the removal of cataract are hereby greatly lessened and the escape of the cataract is facilitated. Drake-Brockman subsequently applied this method of operative procedure to all kinds of cataract and found that the results justified a continuance in the operation. He says: "In no other kind of operation can either so large a surface of the lens capsule be exposed for division by the cystotome, or the iris be kept away from the lens and be rendered less liable to an injury in the division of the capsule." As soon as the nucleus in a Morgagnian cataract has escaped into the anterior chamber, it can be more readily examined as to its size, and the corneal incision can more accurately be made to permit of the escape of that body. The advantages of this plan are:

1. It allows a more extensive laceration of the capsule at the same time that the anterior chamber remains replete with its fluid.

2. It permits of a more complete exposure, and a more thorough knowledge is gained of the size and character of the cataract.

3. It diminishes the tendency on the part of the iris to contract, even after the corneal section has been completed and by this means facilitates the escape of the lens.

4. By it, the possibility is gained of more accurately judging of the extent to which the cornea must be divided to permit of the escape of the lens.

5. The less necessity there is for the introduction of a traction instrument to effect the removal of the lens, the less interference there is with the natural position of the structures of the eyeball.

Of 674 operations, seventy-nine, or 11.72 per cent., were unsuccessful. Of this number, 101 were for Morgagnian cataracts. The iris was excised in only seventy-five total cases. Chloroform was administered in 654 cases, and the iris prolapsed in sixty-four, or 9.46 per cent., the latter accident being due, in several cases, to vomiting caused by the anesthetic. Glaucomatous change occurred on six occasions, but this could not be attributed directly to the operation. In further endeavoring to render the operation still more simple, Drake-Brockman laid aside the needle and in thirty-four cases effected the capsule division by means of the cataract knife "before completing the transfixion of the corneal tissue," i.e., while making the section. Of this number, six proved unsuccessful. In the endeavor to divide the capsule of the lens fully, the iris is more liable to be injured and the lens structure cut into and broken up, so that iritis occurred in greater frequency. As no corresponding advantages were to be gained by this treatment of the lens capsule, it was abandoned in favor of the original procedure of division by the needle, prior to making the corneal section.

In a second communication,[4] four years later, the same author reports 1,433 additional cases operated on during the previous three or four years. Of these, but 5.58 per cent. were failures, a very great improvement over the first series. These results (7.54 per cent. failures), Drake-Brockman claims, contrast favorably with any other method of operation. The procedure was applied to all forms of senile cataract, and in some cases of cortical cataracts, with entirely satisfactory results. The original crucial incision of the capsule was abandoned in the second series, Drake-Brockman having adopted, instead, a linear division along the upper papillary margin. This more simple procedure was found equally effectual. Rohmer[5] practiced extensive discission of the anterior capsule and paracentesis of the anterior chamber, followed by massage, through the upper lid, for several seconds. The opacity was almost complete in from twenty-four to thirty-six hours, and entirely so within three or four days. Extraction was then performed "in a day or two."

Elschnig[6] gave up the discission needle, as it made an easily infected wound and was not well adapted to incising the lens masses, and used a Graefe knife, which was carried in laterally in the horizontal meridian from 1 mm. outside the limbus. Elschnig disapproves of discission for ripening senile cataracts, as all cataracts in individuals above 50, whether mature or not, can be extracted easily, no matter what the condition and proportions of nucleus and cortex. In old patients, Elschnig extracts as soon as the vision has diminished so that the day's work cannot be done.

Mooren[7] used a narrow Graefe knife to split the capsule in immature cataracts, especially in zonular forms.

Jackson,[8] in discussing the technic of discission for maturation, lays stress on the importance of making a small central opening and allowing the aqueous to drain

1. Von Graefe and Mannhardt: Klin. Monatsbl. f. Augenh., 1864, p. 408.
2. Correnti: Imparziale. Fasc., 11, 12.
3. Drake-Brockman: Ophth. Rev., 1884, iii, 243.
4. Drake-Brockman: Ophth. Rev., 1888, vii, 333.
5. Rohmer: Cong. d'opbth. de Paris, 1887; Ann. d'Ocul., xcvii, p. 241.
6. Elschnig: Wien. klin. Wchnschr., 1896, No. 53.
7. Mooren: Operative Behandlung d. natürlich u. künstlich gereiften. Staar Formen, Wiesbaden, 1894.
8. Jackson, Edward: Am. Jour. Ophth., 1898, xv, 9.

off, allowing the lens to be ploughed up with a comparatively small incision, as the consequent reaction is proportional to the amount of soft lens-matter which exudes through the cut capsule into the anterior chamber.

Alessandro[9] advises multiple punctures of the anterior capsule. The discission needle is carried in at the outer quadrant of the cornea and five to ten punctures made. Maturation takes place "in a week or two."

Fage[10] makes a small incision into the anterior capsule in the pupillary area, allows the aqueous to drain off, and then massages through the cornea. Maturation is complete, on an average, in three weeks. Iridectomy is not necessary. Tynen of Austin, Tex., in 1900, reported under the title of "preliminary capsulotomy," a procedure of primary opening of the capsule at the time of operation, using Bowman's stop-needle prior to the corneal section. Tynen believed this to be original with himself, it having been suggested by a case in which there had been prolapse of fluid vitreous and the lens had sunk into the posterior chamber (sic), requiring extraction with iris forceps. When it came to operating on the other eye, Tynen, fearing a similar complication, performed "preliminary" capsulotomy just before making the corneal section and was gratified by rapid and easy, almost spontaneous delivery of the lens, although here, too, a small amount of fluid vitreous escaped. The procedure was then applied methodically, and Tynen refers to thirteen cases. In all but two the healing was uncomplicated, and the final results excellent. The two exceptions were cases in which marked iritis developed, due, as Tynen thinks, to the use of too strong solution of atropin, "crowding the iris up into the neighborhood of the corneal wound." The leading point in the operation, according to this writer, is in making the capsulotomy the primary step, thereby enabling the operator to deliver the lens the very moment the corneal section is completed. When this section is finished, pressure with the flat of the blade causes the corneal opening to gape, when at the same moment counter-pressure with the fixing forceps below aids the expulsion, and the lens slides out through the still open pupil with surprising ease. "The lens, having no other avenue of escape, almost always indicates a tendency to follow the knife as the corneal incision is progressing, and when it is finished the lens is partly in the anterior chamber." Tynen adds that in cases in which the lens is to be dislocated this can be done most easily in performing his "preliminary" capsulotomy, and that the operation then resembles Delgado's. The incision is made in the upper quadrant of the dilated pupil following the curved pupillary margin of the iris. Both the point of the instrument and the field of operation are in full view.[11]

At the 1906 meeting of the American Academy of Ophthalmology, Homer E. Smith, of Norwich, N. Y., reported a method which had as its object "to know in advance the size of the section required, and to make certain an efficient capsulotomy with a maximum of precision and a minimum of risk." The method, he says, is applicable only to such cases as one would select for the simple extraction, and is not the operation of choice when the iris lacks the lustrous appearance of health, when the lens is amber-colored or dark-gray, and when the iris is rigid, with little dilating ability to the pupil. The chief objections to the simple operation, which, according to Smith, is indicated in 95 per cent. of the cases, namely, the difficulties of an efficient capsulotomy, of effective removal of fragments of cortex, and of easy delivery of the lens through the pupil, are met by the method proposed. As to the better visual and cosmetic results, he adds, there can be little question. He then describes a primary capsulotomy with a small Knapp's knife-needle making a crucial incision, "not only through the lens capsule, but partly into the lens-substance itself. If the cut in the capsule is practically invisible, a large nucleus is present, and the usual section of the upper two-fifths of the cornea will be required for the easy exit of the lens. If semi-gelatinous lens-matter escapes, a section of one-third will suffice, while if a milky liquid issues, the cataract is hypermature and the section may be made with the angular keratome. A period of waiting between the capsulotomy and extraction is required for the anterior chamber to reform completely, as there is usually sufficient loss of aqueous to render the eye soft and unsuitable for good section. This loss of time is really a gain in results, for even in four hours there is sufficient imbibition of aqueous to facilitate the separation between cortex and capsule and to make easier the delivery of the lens.

It will be noted that this is the first reference to an artificial maturation of the cataract by means of preliminary or rather primary capsulotomy, the other writers, as, in fact, Smith himself, having laid stress only on the more perfect capsulotomy thus made possible and on the information gained as to the consistency and, indirectly, the proportions of the lens as to the relative amount of nucleus and cortex. The advantages of this form of capsulotomy are presented by a better cutting instrument than the cystotome, the freedom of the section into the capsule from danger of entangling or wounding the iris, and the avoidance of dislocating the lens, as may easily be done when the cystotome is carried far toward the equator. These benefits are inherent in a method which finishes the opening of the capsule without emptying the anterior chamber or allowing the pupil to contract, rupturing the zonule or causing loss of vitreous. It will be noted that stress is laid on the superiority of this procedure as a means of opening the capsule and indirectly of removing cortical débris after extraction.

Recent advances in methods of dealing with the capsule, notably the procedure of tearing out a portion of the central area of the capsule with forceps, such as those devised by Fuchs and by Schweigger, and improved by Knapp, have made this less important if not entirely unnecessary. Short of an extraction in the intact capsule, there is no method which leaves so clear a pupil as that of capsulectomy. The crucial incision with the knife, or stop-needle, interferes with this procedure or renders it impracticable, as the tension of the capsule is reduced so that the forceps will not grasp or, at all events, if it does so, no central portion can be exsected or torn off, the ends curling up at the crossing of vertical and horizontal incisions. The benefits of the complete removal of the capsule may, however, be gained without forfeiting preliminary capsulotomy if we make a peripheral semicircular incision as practiced by Drake-Brockman and originally advocated by Tynen, or make a number of straight, fairly peripheral cuts either horizontal at upper and lower pupillary margin, or vertical at the temporal and nasal edge of the pupil.

9. Alessandro: Arch. d. Ottalmol., 1901, vii, p. 201.
10. Fage: Ann. d'Ocul., 1903, cxxix, 426.
11. New York Med. Jour., Sept. 20, 1900.

In a recent publication[12] Smith reviews this procedure, and now for the first time calls attention to its value as a rapid and safe method of causing operative maturity of senile cataract, by causing separation of the cortex from the posterior as well as anterior capsule, by entrance of aqueous under the capsule through the knife-needle incisions, this process being completed over night. Smith first made this observation by accident; the anterior chamber having been abolished while he was performing discission of the capsule in a case of immature cataract, and being obliged to defer extraction till the following day, he was agreeably surprised to find that the previously clear cortex had become opaque over night, and was able to deliver an operatively mature lens with little or no cortex, leaving a clear, black pupil, and gaining, eventually, 20/30 vision. The original idea of a more effective, complete, and safe capsulotomy, avoiding the dangers of the usual cystotome opening, was now replaced by the hope of causing a rapid maturation of cataract allowing extraction with a minimum of remnant cortex, with the incidental advantage of a more easily delivered lens, little or no necessity for prolonged anterior-chamber irrigation or mechanical expression for removal of retained cortical débris, and a posterior capsule left free from adherent lens-matter. Smith's first experience showed him that the knife-needle could be improved on. The blade was too long and not cutting sharp up to the point. He had constructed a "miniature scalpel" with a cutting-blade 2 mm. long and a slender shank just thick enough to stop the corneal puncture. Smith has not departed from his original crucial incision which is not allowed to penetrate deeply into the lens-substance. For this reason the shank is gradually withdrawn as the knife is carried along in making the incisions. "Were it not for this maneuver the blade would sink dangerously deep into the lens or possibly dislocate it." The only disadvantage of this preliminary capsulotomy, according to Smith, is that it requires more time and trouble as the technic of asepsis must twice be gone over.

We cannot, however, dismiss all objections in a single sentence unless we close our eyes to the fact that it is the danger of infection, even more than the time and trouble of disinfection in a second operation, to which we hesitate to expose our patient and which we would not risk unless there is something definite to be gained. The disadvantages of the ordinary capsulotomy are many, but the main point to be considered in weighing the pros and cons of the new procedure is the question whether we can expect decidedly better visual results and comparatively early operation in immature cataracts with little or no additional risk. The disadvantages of capsulotomy with mature lenses have become negligible quantities since the perfection of the capsulectomy method. The crucial incision rather complicates this and may have to be superseded by the peripheral curved or straight incisions in the capsule which still allow a central portion to be torn out with the forceps. The main advantage of preliminary capsulotomy is the rapid maturation, operatively speaking, of an immature but partly opaque lens by changing of sticky cortex into a homogeneous substance which no longer adheres to the capsule and either comes away with the nucleus or can easily be flushed out of the anterior chamber. As Smith well says: "It makes an immature cataract operable at once and saves the patient much weary waiting and loss of usefulness." The procedure is safe, efficient, and easy of execution. It is adapted to all types of cortical cataracts, but it is particularly of value in the immature variety. It makes the capsulotomy the easiest step in the extraction operation and greatly facilitates the delivery of the lens. Finally, delivery is accomplished with little or no pressure, so that there is less danger of complicating prolapse or loss of vitreous, and a secondary operation is rarely necessary. This last point alone, if borne out by observations and experience of other surgeons, would be sufficient, in my opinion, to constitute this procedure a valuable and important innovation. For the danger of the preliminary capsulotomy would be balanced and wiped out by the fact that the extraction is the last operation. Comparing the two, one would infer, theoretically, that there was less risk in needling the capsule of an immature cataract than in performing discission of a secondary membrane, and this appears to be borne out by statistics and the consensus of opinion among eye surgeons.

Does the adoption of this procedure mean the passing of the immature cataract? If so, it is indeed a boon for patient and surgeon. The operations heretofore performed for maturing a partially opaque lens have been dangerous, ineffectual or unreliable, and all have required, at the shortest, three or four weeks to produce the required effect. Iridectomy, either simple or combined with massage of the lens, through the cornea or directly with the spatula introduced at the time of the iridectomy into the anterior chamber, have been tried and found of doubtful advantage.[13] The dangers have been emphasized, particularly by Major Smith,[14] who says:

> Puncturing the lens capsule with a needle is liable to be a complete failure or to establish a traumatic cataract, which, thus established, may constitute a serious ophthalmic emergency. The formation may be so rapid and the lens may swell up to such a degree as to cause acute glaucoma and the lens-matter may escape into the aqueous chamber and cause acute iritis or iridocyclitis. The extraction of such a cataract admits of no delay. The conditions under which it has to be extracted are highly unfavorable and difficult, and the results are far from being as satisfactory as in the extraction of a cataract matured by Nature's process. It will thus be seen that when this procedure is efficient in maturing a cataractous lens, that is, when it causes a traumatic cataract, it is fraught with serious trouble and serious danger and is now, I think, relegated to the operations of the past.

Far from being relegated to the operations of the past, opening the lens capsule for the purpose of maturing cataract bids fair to be one of the type procedures of the future. The objections raised by Major Smith apply to the needling as formerly practiced, and involve the instrument and the lapse of time between the discission and the intended extraction. In the preliminary capsulotomy of Homer Smith of Norwich, a suitable cutting instrument is used and so little time elapses between its introduction into the eye and the extraction of the cataract that no danger need be feared. High tension might, it is true, develop over night, but the extraction would nip this process in the bud. Iritis could hardly develop if the pupil had been kept dilated, or at least would be in the stage of incipiency and hence easily con-

12. Smith: New York State Jour. Med., May, 1911; Arch. Ophth., January, 1912.

13. Widmark, J.: Review of Methods, Centralbl. f. Prakt. Augenheilk., March, 1897. The authors agree that massage methods (Foerster, Bettmann) are generally effective only when there is a fairly large resistant opaque nucleus to serve as a base (Unterlage). In other cases capsulotomy is the better procedure. The latter procedure was reserved for patients under 40 and never used for the mature senile cataract proper.

14. Tr. Am. Ophth. Soc., 1908, xi, 605.

trolled. The escape of lens-matter into the anterior chamber could hardly cause much trouble in the short time elapsing before the lens is completely removed.

My personal experience with Smith's method of preliminary, or, as I should prefer to style it, preparatory capsulotomy, is very limited, but so far at least, the results in my own cases as well as in those of my colleagues at the New York Eye and Ear Infirmary, who have given this procedure a trial, have been uniformly excellent. Some loss of aqueous or even complete draining off of this fluid sufficient to abolish the anterior chamber for a time does not seem to have any deleterious effect, and reminds us that the procedure of repeated paracentesis of the cornea and evacuation of the anterior chamber after discission was recommended as long ago as 1845, by Werneck,[15] in cases of soft cataract in which maturation was unduly slow. Aside from the ease and accuracy with which the corneal section and the cystotomy can be performed with and after the preliminary capsulotomy, respectively, stress should be laid on economic advantage to the patient of shortening the period of partial blindness and of incapacitation. This applies particularly to comparatively young cataract patients with lenticular opacities of sufficient density to materially interfere with their occupation, a condition found rather frequently in men of from 45 to 50 who work in front of fires, such as glass-blowers, foundrymen, engine drivers and stokers, workers in potteries, brick kilns, and so on. It seems to me that the advantages of the preparatory capsulotomy might be combined with those of excision of the capsule by a slight modification of the knife-needle incisions. If these are made at the periphery, above and below, or at the temporal and nasal margin of the dilated pupil, respectively, we produce the same ripening effect as with a crucial incision through the capsule, with the further advantage of not making it difficult or impossible to tear out a piece from the center of the anterior capsule. The latter maneuver undoubtedly facilitates irrigation of the anterior chamber and intracapsular washing as well and makes it possible to remove mechanically a maximum of cortex with a minimum of traumatism and consequent irritation. The purely optical effect of complete removal of capsule from the pupillary area must be considered as of decidedly beneficial influence on ultimate visual results.

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ABSTRACT OF DISCUSSION

DR. HOMER E. SMITH, Norwich, N. Y.: Dr. Fridenberg makes two parallel incisions in the capsule and afterward uses the capsulotomy forceps, and the capsule will retract along the line of the incisions and prevent the entrance of the aqueous between the capsule and the cortex which hastens the maturation of the lens. Therefore he will have a sticky cortex.

Every step in the extraction of cataract has undergone an evolutionary process, but while the section is practically agreed on, the capsulotomy is not, and this is, perhaps, the most important step in the operation. If the capsulotome was an efficient instrument its shape would have been agreed on long ago; that it is not is proved by the many forms now in use. If the elastic lens capsule be incised it will simply gape; if cross-incised it will open, the size of this opening depending on the length of the cross-cuts. A capsulectomy therefore insures no larger opening for the exit of the lens and the subsequent clarity of the mediums than does a crucial capsulotomy of equal size in the midpupillary space and, moreover, it is the less scientific surgical procedure as it means tearing and not cutting. That it is more difficult and dangerous only emphasizes this. A preparatory capsulotomy is certain, easy of execution, efficient, ample, of clean-cut margins, leaves no capsule in the pupillary space, minimizes the risk of loss of vitreous and, other things being equal, is superior to a capsulectomy. In addition to this a capsulectomy can be made only after the section and the advantage which one gains by a knowledge of the size of the nucleus and therefrom of the proper size of the section is thereby lost. The point to the effect that high tension might develop overnight is well taken. Loss of aqueous during the capsulotomy is an embarrassment as it makes difficult what remains to be done of the crucial incision; following the withdrawal of the knife it is of no moment. The cut is so small that the anterior chamber reforms in a few minutes and with the new knife it rarely happens at all. I must differ from Major Smith of Amritsar in the matter of the operative maturation of the partially opaque lens. That these operations have been failures is due to the essential structure of the capsule and the mode of operating. Small punctures either close or at most produce small islands of opacity just beneath them. Small incisions allow none or but little lens matter to escape and if the lens swells it is most probably equatorially and we get occlusion of the filtration angle. If the incision is large and there is any swelling it is in the polar diameter.

DR. HOWARD F. HANSELL, Philadelphia: I feel that I am not entitled to speak very authoritatively on this operation because I have performed it only five times, but in those five operations I have been gratified beyond expectation in four, and I have come to consider that for the immature nuclear cataract, the kind that requires so many months and years of delay for its maturation, this operation can be done within twenty-four hours after the capsulotomy with perfect safety and assurance that the cortex of the lens will not be left behind. Since reading Dr. Smith's paper in the *Archives of Ophthalmology* for January I have thought rather deeply over the operation, and a week ago I had the opportunity of doing four of these operations together, and the week before one.

I was impressed with the fact that in none of these cases did the capsulotomy increase the opacity of the lens in the twenty-four hours, but only its maturation. In other words the clear cortex adheres to the nuclear as the lens is removed.

DR. G. C. SAVAGE, Nashville, Tenn.: Soon after I received the reprint sent me by Dr. Smith, feeling impressed by the work he had outlined, I proceeded to do it on the left eye of patients, and, by the way, I always leave the capsule in when I operate on the left eye. The ideal capsulotomy has been given us by Homer Smith. It is easy to do and he does it right. The crucial incision, the two lines crossing in the center, cannot be improved on by parallel lines running in any sort of direction. The points at the angle of the crucial incision, as has already been demonstrated, roll outward, but the thing that is accomplished by this device of my friend Smith is the ease with which the lens is expelled. During many years I have been transfixing the lens as it presents itself whether the capsule is left or taken out, so as to do away with continued external pressure on the eye, thus lessening the risk of escape of vitreous; but the lens is so loosened in its capsule when it has had a few hours to be loosened by the aqueous that it comes out before we have time to transfix it, like a bean out of its hull. It is a delight to see how easy it is by this procedure. I do not believe we ought to leave these patients over night. Do the capsulotomy at 8 a. m. and then about 2 p. m. you have all the loosening of the lens that is desirable, and it will come out at the end of six hours with such ease that you will be astonished, and

15. This procedure of Werneck is recommended by Arlt (Graefe-Saemisch Handbook, 1874, III), who attributes its efficacy to mechanical stretching of the already torn or punctured capsule, widening and bursting the tears and deepening the fissures in the lens substance, due to the lens being forced forward. Resorption takes place more rapidly, then, possibly, he adds, because the aqueous, which had become saturated with lens-fiber matter, is emptied out and replaced by fresh fluid of greater absorptive capacity. Arlt considers this procedure less dangerous and accordingly more suitable for repeated application than a "formal" discission.

then you can go to bed and sleep, because the pressure has not ruptured the hyaloid membrane and you have had no escape of vitreous. I honor my friend Smith for the gift which he has given us, but I am sorry his name is Smith, because it is going to lead to a little confusion. Hereafter we shall have to distinguish the two Smiths of cataract fame by calling the one "Indian Smith" and the other "American Smith." Of the two operations given us by these men, grant me the "American Smith's" operation.

DR. S. LEWIS ZIEGLER, Philadelphia: My attention was first called to this method of incising the capsule preliminary to cataract extraction soon after I presented my paper on V-shaped iridotomy and capsulotomy, at the Chicago meeting, in 1908. I received letters from several operators saying that they had used my knife-needle to make a preliminary cystotomy, at some period preceding the operation of cataract extraction. I tried a few of these operations with the V-shaped incision but was not favorably impressed with it and discarded it. I think, however, that we should give this procedure a thorough trial, because there are so very many cases in which we must have some method of maturing the lens, and the Foerster operation does not accomplish this satisfactorily.

In regard to the term to be applied to this procedure, we are apt to become a little confused because we are using the term "capsulotomy" in several different ways. The operation on secondary membranous cataract is properly called a capsulotomy, and it would seem more appropriate to call this procedure cystotomy, or preliminary cystotomy, because the capsule is still intact and is, therefore, a cyst holding the lens. In that way we would be able to make a slight differentiation between these operations. I think the procedure is worthy of our careful study and practice to see just how much we may develop from it.

DR. HENRY DEWITT WATSON, Binghamton, N. Y.: In one case in which I have operated with a capsulotomy preliminary to the extraction performed according to Dr. Homer E. Smith's method, the patient was a woman, 47 years old, who had been in ill health for six or seven years with a diagnosis by several internists of pernicious anemia. When she was referred to me last November, she gave a clinical picture of marked anemia with great emaciation. Her vision in the right eye was counting fingers readily at about 2 meters, and in the left eye the vision was 20/197. Her vision was sufficiently obscured to annoy her, and therefore to have a depressing influence on her mind. The eyes presented nothing out of the ordinary but because of the pronounced immaturity of the lenses and fear of an undesirable reaction I decided to do a preparatory iridectomy, with preliminary opening of the capsule. The right eye was chosen because of the slightly lesser vision. Six weeks after the iridectomy the lens was extracted. The capsule was opened as described by Smith at about 3 p. m., the eye bandaged and the patient placed in bed. She had no discomfort, and at 9 o'clock the following morning when the bandage was removed the eye showed very little reaction. The two incisions in the capsule were noticeably spread and presented an appearance as if the lens substance were slightly protruding. A section was made in the limbus about 2 mm. above the horizontal meridian of the cornea and the lens delivered in the ordinary way, but this required only very slight pressure. The pupil was clear and black, the toilet was made and the eye bandaged. The subsequent course was ordinary. In three weeks with an approximate correction the vision was 20/30. Three weeks later, because of some wrinkling and slight opacity of the capsule, I opened according to the method of Ziegler. With her correction she now has 20/16 vision.

Clean Milk.—The only reason why we do not have clean milk is that it costs more than dirty milk, though in the long run the cost of clean milk is less. If we could only impress the latter fact on the public the sanitation of our milk-supply would go forward rapidly.—*Dietetic and Hygienic Gazette.*

VISUAL RESULTS AFTER THE SMITH OPERATION FOR CATARACT

D. W. GREENE, M.D. AND J. W. MILLETTE, M.D.
DAYTON, OHIO

So much has been said and written concerning the merits and demerits of this operation in the last few years that it may be assumed that the profession is generally well informed as to the indications for the operation, the operative technic, the accidents and complications which may follow it, so that little remains to be said along these lines. The phase of the operation to which we wish to call attention, aided by statistics, is the excellence of the visual results which can be secured by it in all stages of cataract, as this is not so generally appreciated as it deserves to be.

In order to present a summary of our visual results, we shall be obliged to depend on a comparison of statistics; the subject will not admit of treatment in any other way. We think it will be fair to the operation, and aid to a better understanding of our purpose, if we exclude from these visual tables cases complicated by unrecognized fundal disease, lacrimal disease and central opacities of the cornea and retention of ruptured capsule, unless it has been extracted, wholly or in part, as a step of the operation.

These statistics of unselected cases will show that taking large numbers of operations, all other things being equal, vision will average very much better one to two months after the intracapsular, than after the regular operation, and if the visual results are measured by the same standard; surely we are subjecting it to as severe a test as can be required of any cataract operation.

As the profession has a right to ask for the facts and figures on which the above claim of superior vision is based, the following recent visual statistics of the regular operation are offered for comparison.

Knapp, whose unequaled experience as a cataract operator has made him an authority, has given us the following standard for estimating vision, which by common consent is generally accepted. He said:

> We should consider vision of 20/200 to 20/20 as constituting a first-class result, vision from 18/200 to 1/200 a moderate result and mere perception of light and blindness as failures.

In the same connection, he has said:

> The average result of primary vision after extraction, simple as well as combined, computed from many hundreds of cases is 20/70, that of ultimate and permanent vision after discission 20/30.

No one will question the reliability of the statistics just given of ultimate vision in the skilful hands of Knapp, or operators of his class, but we believe, from a large experience, that this is too high a standard for the average operator. The statistics to follow will show that 20/40 is nearer the vision secured.

Under the standard just given the following statistics have been compiled by Theobald of Baltimore.[1]

RESULTS OF TWO HUNDRED AND FIFTEEN CONSECUTIVE EXTRACTIONS OF CATARACTS

> "Combined extraction was done in ninety-four cases, extraction after preliminary iridectomy in seventeen cases, simple extraction (unintentional) in one case, extraction in capsule without iridectomy (unintentional) in two cases, and suction extraction in one case of traumatic cataract."

1. Theobald: Summary of Results Obtained and Features of Interest in 215 Consecutive Cataract Extractions, Tr. Am. Ophth. Soc., xii, 84.

Successes (vision 20/200 to 20/20)	178
Successes (vision not recorded)	15
Total successes	193
Partial successes (vision 6/200 to 18/200)	10
Partial successes (vision not recorded)	3
Vision not improved, though operation was smooth	2
Failures from suppuration	4
Failures from other causes	3
Total operations	215

Vitreous was lost in 15 operations, or 7 per cent.

The seven failures recorded represent a loss of slightly more than 3.24 per cent.

The visual acuity obtained in the successful cases, omitting the fifteen in which it was not recorded, was as follows:

20/13..... 1	20/50.....19	20/120..... 7
20/15..... 1	20/60.....10	20/125..... 2
20/20..... 4	20/70.....16	20/150..... 1
20/25..... 3	20/75..... 6	20/?.....14
20/30.....31	20/80..... 7	
20/40.....25	20/90..... 6	Total.....178
20/45..... 3	20/100.....22	

Duncan[2] has reported the following summary of visual results in 100 extractions of cataracts: "eighty-six senile, seven soft, and six congenital."

While it is not stated, we think it is fair to assume that a large percentage of Duncan's statistics apply to mature cataract, and that the usual percentage of discissions were performed to secure the vision reported.

After 100 regular operations, he gives the following figures:

No. Cases.	Vision Equaled.	No. Cases.	Vision Equaled.	No. Cases.	Vision Equaled.
32	20/20	14	20/50	1	10/200
25	20/30	4	20/80	4, no report.	
12	20/40	5	20/200	3, failure.	

Vision in 96 cases approximately.....20/31
Vision in 93 cases approximately.....20/30

It will be observed that practically one-third of 100 cases are credited with 20/20 vision. This is not in harmony with Knapp's, Theobald's or our own statistics of vision after the regular operation.

At the meeting of the Section in Atlantic City in 1909, Greene[3] submitted the visual statistics of seventy-five cases of cataract operated by regular methods, with thirty-five discissions and nine refused discission, with the following showing:

No. Cases.	Vision Equaled.	No. Cases.	Vision Equaled.	No. Cases.	Vision Equaled.
10	20/20	5	20/60	1, fingers at 6 ft.	
10	20/30	2	20/70	1, percep. of light.	
17	20/40	7	20/100	1	0
10	20/50	5	20/200		
				75	

Average vision equaled 20/40.

Those who are favorably disposed to the intracapsular operation are willing, as a test of its merits, that its visual results shall be measured by the Knapp standard for the regular operation, as given above, and will not ask that its statistics of vision be restricted to mature cataracts, as those of the regular operations are as a rule, but that they shall apply to all stages of cataract.

Extracting unripe cataracts by regular methods (except when the lens is uniformly sclerosed) is a very unsatisfactory method of dealing with them, and, in our experience at least, cannot furnish such visual statistics as have just been given. We do not think that there is a confrère present who would care to present a paper to the Section on the visual results he had obtained in 100 consecutive operations by capsulotomy methods, even though he had recourse to the latest ripening method (Smith, of Norwich, N. Y.). It is in the treatment of unripe cataracts, whatever their nature, that intracapsular extraction is especially indicated and achieves its highest successes. This is not an *ipse dixit* statement, but is corroborated by the experience of many operators.

No large numbers of statistics have yet been compiled, from which those who believe that a higher average of vision can be secured by the intracapsular than by the regular operation can prove their contention, or by which those who wish to compare the visual results of the operation with those of the regular operation can find statistics for the purpose. Yet, those to whom experience has shown the higher grade of vision must believe what they have seen.

Unfortunately conditions in northwestern India, in which large numbers of visual statistics for the intracapsular operation should be compiled, are not favorable for the collection of these statistics; and the unusual presence of trachoma, opacities of the cornea, and the frequent presence of disease of the fundus affect the average of vision.

The small number of operations performed outside of India increases the regret that the wealth of material there has not, and we think cannot, be made available to any considerable extent for compiling statistics to show the visual superiority of the intracapsular operation.

We aim to gather the small numbers of Indian and American statistics for the purpose of comparing these operations in visual results. Operations for cataract have but one purpose, namely, the restoration of vision, and if it can be shown that the intracapsular yields a high percentage of successes, and higher average of vision, in all stages of cataract, than the regular operation, it will grow in professional favor against all opposition.

The complications which follow are comparatively mild and, as a rule, respond more readily to treatment, so that fewer total losses from painful inflammatory conditions follow it than follow the regular operation. These reasons and the increased visual acuity, in our judgment, more than offset the complications.

In our experience, if the capsule does not rupture, about 90 per cent. of the cases complicated by loss of vitreous will have about the average and, in many cases, high-grade vision, and the remaining 10 per cent. will show as good average vision and no more total losses than after the same accident in the regular operation. In some complicated cases, good or useful vision may be secured by proper medical treatment, which might be lost without it, or the result be indifferent.

These remarks are offered in an explanatory, not in an apologetic spirit, because in the end the operation must stand on its own merits and be judged by some criterion. The best criteria are comparative freedom from inflammatory complications and higher average vision; if it cannot furnish these, it will fail to win professional favor.

Greene, during his stay of six weeks in Smith's clinic in India, became satisfied that the want of definite knowledge of the amount of vision secured by the operation was the weakest act in the great "Jullundur show." Any one at all familiar with the appearance of cataract eyes would have to concede that a very high percentage should have high-grade vision; but any one familiar with the situation there knows that carefully worked out statistics of visual results, to confirm this statement, cannot be secured unless more assistants are provided, or unless some way is found to have patients return later for examination and glasses.

2. Duncan: One Hundred Consecutive Cases of Cataract Extraction, Arch. Oph., xxxvii, 300.
3. Greene: THE JOURNAL A. M. A., Sept. 4, 1909, p. 777.

Smith's[4] statistics of 99.27 per cent. of first-class results, Gidney's[5] 91 per cent. and Vail's[6] better than 97 per cent. should be considered surgical successes, not the showing of carefully tested vision; while the results would undoubtedly average high, yet as a rule, they are only estimates made from the appearance of the eye when discharged from the hospital. Greene's 356 Indian operations are of the same class, and Smith[7] has said that "all the statistics of the government hospitals in northern India are based on the same plan."

Fortunately, a few Indian operators have furnished statistics of the amount of vision they have secured by actual tests with lenses. These are of value because they throw light on what many consider the greatest weakness of the operation, namely, that no large numbers of statistics of vision have been furnished up to this time.

Lister[8] says:

> It is quite impossible to give a statement of the exact vision obtained by every patient operated on in Indian hospitals in the provinces. At Jullundur, owing to the deficient accommodations, the patients are allowed ordinarily to leave the hospital on the sixth day.
>
> The eye is still weak and cannot tolerate light well enough to allow the vision to be tested at a distance. In Meerut, my patients are discharged on the tenth day, but that also is too early to allow their vision to be tested other than roughly. I show the patients groups of small dots varying in size from one readily seen to one as big as the ordinary full stop in print. They are asked to count these with a + 10 D. lens. If they can count down to the last size but one, I am sure, from experience, their vision will be about 6/6 when the cornea has settled down. This may not appear very scientific, but it is all one can do, and it is for all practical purposes sufficient. I have had the opportunity of seeing and testing many patients of my own and of Major Smith's who came back for various reasons, and from an experience which is based on certainly not less than 250 of these cases I should say that the average vision obtained after this operation, provided the eye was healthy before operation, is 6/6.

Lister[9] has also reported and commented at length on ninety-eight cases operated by Smith, complicated by loss of vitreous, the average time after operations being 3.706 years, varying from six months to nine years. After excluding cases complicated by opacity of the cornea, capsule left behind and disease of the fundus, he had sixty-one cases which he tested with spherical lenses and reported vision as follows (no attention was given to the correction of astigmatism):

No. Cases	Vision Equaled	No. Cases	Vision Equaled	No. Cases	Vision Equaled
4	6/3	5	6/4.5	2	6/8
6	6/3.5	4	6/5	3	6/9
4	6/4	33	6/6		

Approximately 6/5 vision for all.

Oxley,[10] in 100 unselected cases, reported visual results as follows:

No. Cases	Vision Equaled	No. Cases	Vision Equaled
52	6/6 to 6/8	6	6/20 to 6/30
26	6/10 to 6/15	13	below 6/30

Vision in both reports is probably too low because astigmatism was not corrected.

Gidney[11] refers to 100 cases of double cataracts (200 extractions) made by him, in which one eye was operated on by the intracapsular method and the other by capsulotomy. He did not pick or choose the cases as to their suitability to one or the other operation, except that all immature cataracts were extracted in the capsule, and the capsule was lacerated when there was evidence of increased tension (this was present in six eyes). The following tables speak for themselves; they prove most conclusively that vision is more acute. His results were worked out in Jessop's classification; that is, a "success" when with glasses vision is at least 6/36; "partial success" when vision is less than 6/40, and at least large objects are distinguished; "failure" when there is "perception of light only."

TABLE 1.—RESULTS OBTAINED FROM OPERATION BY THE INTRACAPSULAR METHOD IN 100 CASES OF DOUBLE CATARACTS

Variety of Operation	Nos. Operated On	Visual Results								
		6/6	6/8	6/12	6/18	6/24	6/36	6/60	Below 6/60 and Counting Fingers	Vision Lost
Intracapsular.	100	27	13	13	16	15	6	4	5	1
Capsule laceration.....	100	4	3	11	20	18	19	13	10	*2

* Includes one panophthalmitis due to lacrimal disease.

In America the situation is very different from that in India; here, we think statistics of the quality of vision secured by the operation must be largely compiled. Our patients are more intelligent, they need their eyes for close work, and private patients clamor for the best possible vision, and as a rule have means to remain long enough in the hospital to be treated for complications which may interfere with the attainment of the best possible vision, or they can come back later for examination and glasses.

Tivnen,[12] in the discussion, "Delivery of the Lens," in the symposium on senile cataract before the Chicago Ophthalmologic Society, Nov. 20, 1911, said that he had received 160 replies to the series of questions he sent to a large number of oculists, asking for their experience with, and attitude toward, the Smith operation; 111 (69.3 per cent.) had not performed the operation. In answer to his third question, "Has the Smith operation in your experience secured either an increase or a more satisfactory visual acuity than the capsulotomy method?" forty-nine replied that they had performed the operation; fifteen (30.6 per cent.) reported an increase and more satisfactory vision by the Smith method; eleven (22.4 per cent.) reported inferior by the Smith method; four (8.1 per cent.) reported vision equal by either method, and nineteen (38.7 per cent.) expressed no opinion.

Wurdemann[13] had reported the visual acuity of forty patients after intracapsular operation as follows:

> Good results equal to 6/6 to 6/9 in 34.
> Poor results equal objects in 2.
> Failures in 4.

Greene[14] reported visual results in twenty-two intracapsular extractions which he performed after reading Smith's paper,[15] and with no other instructions, with the following showing:

4. Smith: Arch. Ophth., xxxiv, 602.
5. Gidney: Tr. Bombay Med. Cong., 1909, p. 502.
6. Vail: Arch. Ophth., January, 1912.
7. Smith: Ophthalmoscope, 1912, xii, 179.
8. Lister: Tr. Bombay Med. Cong., 1909, p. 521.
9. Lister: Tr. Bombay Med. Cong., 1909, p. 523.
10. Oxley: The Complete Removal of Cataract, Tr. Bombay Med. Cong., 1909, p. 512, and Indian Med. Gaz., March, 1908, p. 512.
11. Gidney: Tr. Bombay Med. Cong., 1909, p. 496.
12. Senile Cataract, The Cleveland Press, Chicago, p. 94.
13. Wurdemann: The Expressions of Cataract in the Capsule, with Report of Forty Operations, THE JOURNAL A. M. A., Sept. 4, 1909, p. 782.
15. Smith: Arch. Ophth., 1906, xxxiv, 601.
14. Greene: Am. Acad. Ophth. and Oto-Laryng., 1906, p. 70.

63.3 per cent. were mature.
18.2 per cent. were immature.
4.5 per cent. were traumatic.
9.0 per cent. were hypermature.
Vitreous loss, 41 per cent.

Capsule ruptured in 50 per cent. of cases, average of vision of fifteen given glasses practically 20/40. This would probably have been higher had the patients been more carefully tested, but the high average vision after the operation was not appreciated at the time.

In 1909, Greene[16] presented a report to this Section on the visual results of seventy-five operations made by the Smith method, as its technic was then understood, which averaged 20/27, as follows:

TABLE 2.—SUMMARY OF VISUAL RESULTS; TOTAL NUMBER SEVENTY-FIVE

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
3	20/15	4	20/40	2	P. L.
30	20/20	9	20/50	1	0
18	20/30	5	20/70	3	No record.
				75	

This was the work of an amateur, before Greene had had the advantages of instruction at Smith's clinic.

Ray[17] has reported the average visual results of eight of thirteen Smith operations performed by himself as 20/30. Seven were immature, four were mature and two were hypermature; one had slight loss of vitreous.

In May, 1908, Wood of Chicago and Jackson of Denver spent two days in Dayton; they witnessed nine operations, and examined with all the instruments of precision forty-seven other patients who had been operated on, from a few days to three or more years previously.

Wood[18] read a report at Atlantic City in June of the same year, in the discussion of Greene's paper, "Experience in the Expression of Cataract in the Capsule by the Smith Method," and said later, in 1910, that he still contended for the truth of the remarks he made in the discussion at Atlantic City. In speaking of the vision of these patients, he made the following statement:

> Of the forty-seven examined by the ophthalmoscope, etc., I never saw a single case of glaucoma or detachment of the retina. . . . The proportion of unusually good vision (20/15 to 20/20) was, I believe, greater than results from ordinary methods of extraction. I have not only found central vision in those cases already reported by Dr. Greene to have been correctly reported, but, in some six instances, to have been better than that set forth in the report.

This is a circumstance that lends plausibility to the assertion that, while sight tends to deteriorate, chiefly as the result of opacification of the capsule during the first six months following the older methods, it improves in the Smith operation, owing to the absorption of intraocular bleeding and the reestablishment of normal vascular conditions.

If from this slight experience I might be allowed to venture an opinion as to the place of the Smith operation in ophthalmic surgery, I would say that, given an experienced, intelligent and skilful operator, working in conjunction with the tried and equally experienced assistant, and counting successes in cataract extraction entirely from the amount, quality and persistence of central sight, six months after the operation, the Major Smith procedure is the best method for extracting all forms of senile cataract with which I am acquainted.

16. Greene: Experience in the Expression of Cataract in the Capsule by the Smith Method, THE JOURNAL A. M. A., Sept. 4, 1909, p. 777.
17. Ray: Lancet-Clinic, July 22, 1911, p. 54.
18. Wood, Casey A.: THE JOURNAL A. M. A., Sept. 4, 1909, p. 707; see also Practical Medicine Series, 1910, III, 62.

In patients under 70 years, in good physical condition, who have good perception and projection of light and with uncomplicated operating and healing, we are disappointed if we do not secure vision of 20/20, in many cases 20/15, and in a few cases even 20/10; this high grade vision is seldom secured by the regular operation, and if secured, tends to deteriorate from opacity and wrinkling of the capsule.

In the following tables, we show the vision obtained after rejecting the classes of cases already referred to. We have included all the cases in which we have operated by the Smith method, the patients having been cared for by ourselves, of which we have a complete record while in the hospitals and of such as have returned for examination and glasses. They do not include any of Greene's 356 operations made in India. These statistics only include the visual records of a few of the large numbers of exhibition operations which have been performed away from home, in strange hospitals, often without a trained assistant, and in the presence of a crowd of spectators. An operator is not generally at his best under these conditions, and visual results are not likely to be up to the standard of his own hospitals.

In a few cases these visual results have been secured only by a secondary operation. In several other cases, already referred to, constitutional and local treatment have been of great service in securing these visual results. A condensed summary of the results of the 203 operations will be given together with a few explanatory remarks.

ST. ELIZABETH'S HOSPITAL.—TOTAL NUMBER OF OPERATIONS, 93; AVERAGE AGE OF PATIENTS, 63.64

Immature cataracts 55
Mature cataracts 36
Hypermature cataracts 2
Total 93

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
3	20/10	3	20/40	1	20/200
22	20/15	4	20/50	2	P. L.
29	20/20	5	20/70	1	0
17	20/30	2	20/100	4	No record.
				93	

In the eighty-nine cases of which we have records there was an average vision of 20/22. In the eighty-six cases, which do not include the three failures, there was an average of approximately 20/21.5.

Vision after four discissions for thickened hyaloids was 20/15, 20/20, 20/20 and 20/20 respectively.

First-class results, 96.6 per cent.

SOLDIERS' HOME HOSPITAL.—TOTAL NUMBER OF OPERATIONS, 110; AVERAGE AGE OF PATIENTS, 67.95

Immature cataracts 44
Mature cataracts 59
Hypermature cataracts 7
Total 110

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
1	20/10	9	20/40	5	P. L.
14	20/15	10	20/50	3	0
32	20/20	8	20/70	6	No record.
18	20/30	2	20/200	110	

In the 104 cases of which we have records there was an average vision approximately 20/27. In the ninety-six cases (which do not include failures) there was an average vision approximately 20/25.

Vision after iridotomy for six high pupils averaged 20/70.

First-class results, 92.3 per cent.

TOTAL LIST.—AVERAGE AGE, 66 YEARS

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
4	20/10	12	20/40	3	20/200
36	20/15	14	20/50	7	P. L.
61	20/20	13	20/80	4	0
35	20/30	4	20/100	10	No record.
				203	

Of the four total failures, three were lost by purulent infection; one was lost by non-purulent infection (iridocyclitis).

Of the seven patients who had only perception of light, two had kerato-iritis (delayed healing); two had vitreous loss (excessive); one had macular chorioiditis; one had myopia 20 D. (severe reaction, probably detachment of retina); and one had iridocyclitis (from exposure).

Of the ten without visual records, two were absent without leave from the "Home;" three died while in the hospital; two left the "Home" before vision was tested, and three have not returned for examination.

The 193 patients of whom we have records of vision had approximately 20/25, and 182, not including the failures, had vision approximately 20/23. Total first-class results, 94.6 per cent.

VITREOUS LOSS, ST. ELIZABETH'S HOSPITAL

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
2	20/15	1	20/40	1	P. L.
2	20/20	1	20/50	1	No record.
3	20/30	1	20/70	12	

One patient expelled lens and a large quantity of vitreous on completion of the section. This would have happened in any operation, but it is counted.

Eleven with records had approximately 20/28, after deducting 1 P. L., and ten had approximately 20/25.

VITREOUS LOSS, SOLDIERS' HOME HOSPITAL

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
1	20/15	1	20/40	2	P. L.
4	20/20	4	20/50	17	
4	20/30	1	20/70		

In seventeen cases there was approximately 20/33 vision; after deducting two failures the remaining fifteen cases had approximately 20/29.

These tables seem to show that vision is not so good after vitreous loss in patients who average 67.95 as in those who average 63.64 years.

TOTAL NUMBER OF VITREOUS LOSSES IN 203 OPERATIONS

No. of Cases	Vision	No. of Cases	Vision	No. of Cases	Vision
3	20/15	2	20/40	1	No record.
6	20/20	5	20/50	3	P. L.
7	20/30	2	20/70	29	

Percentage 14.2.

Twenty-eight patients had vision of approximately 20/31; twenty-five, approximately 20/29.

The average strength of cylindric lenses in 117 cases was 2.37 D.

The average amount of astigmatism in 182 cases (the total number refracted) was 1.52 D.

19 North Perry Street—210 Reibold Building.

ABSTRACT OF DISCUSSION

DR. J. W. MILLETTE, Dayton, O.: In our report we have excluded the ruptured capsule cases. We thought at the time the paper was written that the rupture of the capsule robbed the operation of its most distinctive feature, and it was no longer an intracapsular operation. Since the paper was placed in the hands of the Association I am convinced that this is not the fairest way to look at the question. This is one of the complications of the operation, and will come to all men who operate by this method. In the 219 operations here considered there were sixteen ruptured capsules, or 7.3 per cent. As the retention of cortical matter and prolapse of the iris are very undesirable complications in the capsulotomy method, so is ruptured capsule in the intracapsular method a much-to-be-regretted complication. It would not be considered wise to exclude the former from statistics of the capsulotomy method nor should the latter be excluded from our statistics. I desire, therefore, to give the following brief statement of some of the findings including the ruptured capsule cases: There were sixteen cases not included on account of ruptured capsule. In one vision was *nil*, in one other it was perception of light. In fourteen others the vision ranged from 20/200 to 20/15. The average of the sixteen, including the two failures, is 20/37. Of the fourteen, excluding the two failures, it is 20/32. Adding these sixteen to the 193 cases of which we have record, considered in the paper, we have a total of 209, the average vision of which is 20/25.25. Adding the fourteen with ruptured capsule to the 182 of the paper all of whom had vision 20/200 and better, we have a total of 196 with an average vision of 20/23.5. We also excluded from our report eight cases with corneal opacities, in which operation was performed with the hope only of slight improvement of vision; two amblyopic eyes operated on and not recognized, a condition of which we were informed after the operation. Two cases of undiscovered optic atrophy, and one of central chorioiditis were also excluded from the statistics.

DR. D. W. GREENE, Dayton, O.: Perhaps an explanation of the method of testing the vision of these patients will not be amiss. This seems desirable as we have not found among those who have visited our clinics and examined large numbers of cases, entire unanimity of opinion as to the best methods of securing and recording the vision of cataract patients. The difference of opinion relates to the illumination of the card, the color of the card and letters, whether the patient should read every letter of a line to be credited with it, or whether 4/5 or 7/8 should entitle a patient to credit for the line, and on different cards and on different days. Our method has been as follows:

Distance, 20 feet, Snellen's cards, white background and black letters, or black background and white letters in an illuminated cabinet; the test for astigmatism has been carefully made, and we have used the best record obtained after an average of three tests. In a majority of cases, during the first month or six weeks after operation patients will read one and sometimes two more lines of the black card with white letters than on the other card. Many of the cases of this series have been refracted by outside men and the vision in the tables is their finding, not ours alone.

DR. WALTER R. PARKER, Detroit: The only common ground we have with those who have been in India is "visual results obtained." Drs. Greene and Millette say that Major Smith himself counts his success or failure entirely by actual appearance of the eye from one week to ten days after operation, and not by the test with lenses.

It seems to me that Drs. Greene and Millette by their exclusion of retained ruptured capsule cases have given us the results that will be obtained by the Smith operation when perfectly performed on an otherwise normal eye, rather than the result of a clinical procedure for the removing of the crystalline lens, which will give a better average than is now obtained by the older methods. I can understand why a case in which an accident occurs during the operation up to the time when the lens is to be delivered might be excluded from their table, but any result that might arise in consequence of an accident in the attempt to deliver the lens in its capsule should militate against the operation as a clinical procedure. For instance, if on completing the corneal incision, the patient becomes unruly, and the lens is forcibly expelled with loss of vitreous, or if an accident occurs during the iridectomy, it seems to me these cases should not be included in compilation of visual statistics for the Smith operation; but if the capsule is ruptured and left behind during the delivery of the lens in this operation, I think such cases should be included. In the same way, cases with any disturbance of the anterior vitreous which might arise as a consequence of the operation, should be included. It would be just as fair to exclude from our statistics of the older method all cases in which some cortical matter is left, on the ground that if the operation be perfectly performed, no cortical débris will remain. No definite scientific conclusion as to the relative efficiency of different methods of procedure can be reached until we have more uniform standards of comparison.

I have no doubt whatever that the combined operation with capsulectomy is a better procedure in the majority of cases than either the simple method, or the extraction in the capsule. On the other hand, I believe the operation of extracting the lens in the capsule is well adapted to certain cases and that the characteristics of the cases to which it is applicable, while not yet completely known, will ultimately be determined.

The most successful cataract operator will be the surgeon who selects the method of procedure best suited to the individual case rather than he who adopts any one method of procedure to the exclusion of all others.

DR. HIRAM WOODS, Baltimore: I saw Dr. Greene operate, at his invitation, and he gave me opportunity to examine a number of patients whom he sent at random. I believe that the visual results by a careful examination would have been better than in the hurried examination I was able to make. Two or three things struck me. One was the greater visual acuity when examined with black background and white letters. I recall one man who read with a plain spherical of 11 D. 20/15 with the black card and white letters and fell down to 20/30 with the black letters on the white background. Dr. Greene told me that that was a pretty constant observation.

Another thing that struck me was that with several patients I obtained greater visual acuity with the spherical, without attempting to correct the traumatic astigmatism, than in my own cases; in other words, contrary to what I expected, there seemed to be less postoperative astigmatism than I usually observed. A third point is that in spite of the acuteness of vision a number of patients had definite small punctate deposits on the hyaloid membrane. What they were from I do not know. Dr. Greene said they were quite common. There was no question that in the patients Dr. Greene allowed me to examine the visual acuity was greater than we are accustomed to get in our primary tests after capsulotomy.

EYE COMPLICATIONS CAUSED BY HOOKWORM DISEASE

WITH SPECIAL REFERENCE TO THE FORMATION OF CATARACTS

F. PHINIZY CALHOUN, A.B., M.D.

ATLANTA, GA.

Eye complications caused from or associated with hookworm disease have been known for many years. Rampoldi,[1] in 1880, first mentioned these changes, and he described a patient "who passed a great number of eggs in the stools and who only complained of slight asthenopia. The retina was discolored, characteristic of edema of this membrane." Another case in a woman "who died of hydremia caused from this disease, in which there was a true exudative retinitis in each eye." Later, in 1892, the same author describes a case of retinal hemorrhage, and also a case, in a girl of 19, in which he had observed a strabismus which rapidly disappeared when the patient was cured of the hookworm disease.

In my search through the literature of the older writers on the subject of *Ankylostoma duodenale* or hookworm disease of the Old World, I could find but few references relating to eye-changes, and our present-day writers and clinicians have added little to what has been recorded.

In addition to the eye-changes above mentioned by Rampoldi, Nieden,[2] a later writer, much quoted, describes fully his experience in 180 cases observed, estimating that fully 7 to 8 per cent. had some retinal changes, viz., an anemia, arterial pulsation, serpentine veins, great pallor of the disks and hemorrhages. While he admits that any or all of these might occur in chlorosis or other anemia, there is in his mind a characteristic picture of retinal hemorrhage due to hookworm disease. These hemorrhages occur in the peripheral portion of the retina, more numerously and earlier than near the papilla or macula and are frequently herded together in groups of punctate form, close to each other without melting into one another. He also describes another form of hemorrhages which occur in stripes and follow the course of the vessel. These lie near the papilla.

A third form is mentioned as occurring in advanced cases in which there is marked extravasation of blood into the retinal tissue. The two latter types are not wholly characteristic of hookworm disease.

Fischer[3] also mentions retinal hemorrhages and Hansell's[4] case was most interesting. Both papillæ were swollen and their outlines lost. There were linear extravasations of blood in one eye and subretinal hemorrhage in the region of the fovea in the other. The retinal arteries were distinguished as transparent lines and appeared to be filled with water rather than blood.

Hisaki,[5] a Japanese observer, E. Fischer,[6] Fuchs,[7] Lippitt[8] in Porto Rico, and others, corroborate what has been previously mentioned relative to retinal changes, which makes it the most common of ocular complications.

Other changes of a general character, beside the retinal alterations and Rampoldi's case of strabismus, are recorded in the vast supply of literature on hookworm disease, written by clinicians of general medicine. They are particularly mentioned by Ashford,[9] in his exhaustive report of the Hookworm Commission in Porto Rico, and are as follows: blurred vision, dilated pupils, diplopia, unilateral and bilateral nystagmus, amaurosis, restriction in visual field, night blindness and other asthenopic symptoms which might occur in any protracted illness in which there is an anemia.

Ashford lays particular stress on night blindness; he says that it is not a symptom to be ignored. It is variously estimated by different observers as occurring in from 3 to 24 per cent. Corneal ulcers have been reported by Ashford in one of his series, also by Mauldin,[10] while Calmette and Breton also mention a discoloration of the chorioid. Lutz[11] mentions a very rare symptom, that is, chemosis of the bulbopalpebral fold, which occurred three times in twenty-five cases.

Of diagnostic importance, says Stiles, our foremost worker in hookworm disease in this country, is the condition of the pupil. This phenomenon is as follows:

"If the patient is directed to stare intently into the observer's eyes there will be noticed a symptom which is difficult to describe, but which I have found more constant than all others noticed, namely, after a moment the length of time apparently varying slightly, according to the degree of the disease, the pupils dilate, then the patient's eyes assume a dull, blank,

1. Rampoldi: Cong. période. internat. d'ophthal. 1880, Milan, 1881, p. 283; Ann. di ottal., Pavia, 1892, xxi, 357.
2. Nieden: Compt. rend. Cong. internat. de méd. 1897, Moscow, 1898, vi, Sec. 2, p. 60; Centralbl. f. prakt. Augenheilk., Leipsic, 1903, xxvii, 207.
3. Fischer: Ber. ü. d. Versamml. d. ophth. Gesellsch., Stuttgart, 1892, xxii, 26.
4. Hansell: Tr. Am. Ophth. Soc., Hartford, 1901, p. 377.
5. Hisaki: Chiba Igahuhwai-Zassh., Tokyo, 1900, No. 47, pp. 1-7.
6. Fischer: Centralbl. f. prakt. Augenh., Leipsic, 1896, xx, 81.
7. Fuchs: L'Ankylostomiase, maladie sociale, Calmette and Breton, Paris, 1905, p. 55.
8. Lippitt: See Ashford's report, Note 9.
9. Ashford: Uncinariasis in Porto Rico, Cong. Third Sess., Doc. 808, 1911.
10. Mauldin: Jour. South Carolina Med. Assn., 1910, vi, 521.
11. Lutz: Samml. klin. Vortr., Leipsic, 1886, No. 88.

almost fish-like or cadaveric stare, very similar to that noticed in extreme alcoholic intoxication."

I have never looked for this symptom, therefore I cannot speak from experience.

Dinsmore of Alabama, in a personal letter, expressed great faith in it, while Ashford of Porto Rico and Dock[12] of St. Louis do not believe it diagnostic.

In presenting this subject I wish to call attention to other eye disorders associated with, if not caused by hookworm infection. They are cataracts in the young and spontaneous hemorrhage from the conjunctiva.

Soon after hookworm disease was discovered in Georgia and the South, about 1904, when there was so much talk, in earnest and jest, that the germ of laziness had been found, my father, Dr. A. W. Calhoun, had two young people from Florida, affected terribly with anemia, dropsy, more or less stunted in mind and body, who had cortical cataracts. In one case he performed a discission, and in the other an extraction after iridectomy, with good results. I suggested that we make an examination of the stools for the detection of larvæ of hookworms as the patients looked to be fit subjects, and, to our astonishment, their stools were found to be loaded with the eggs. He reported these, and made mention of others under the title of "Association of Hookworm Disease with Cataract," before the Georgia State Medical Society.[13]

Since that time I have been watching for these cases, and not until last year did I find them. Two other cases of cataracts in young patients associated with hookworm disease, were reported at the 1910 meeting of the Georgia State Medical Association and later published,[14] and to make this article more complete, I herewith attach the cases from that report.

CASE 1.—*History.*—L. M. R., aged 20, an ignorant country lad from the back woods near Ellijay, Ga., was referred to me by Dr. J. E. Tankersly. The boy was so ignorant or frightened at the time of my office examination that I could obtain very little history from him, except that the right eye had gradually gone blind in the past three months; formerly, the patient thought, he had as good vision as any one. Dr. Tankersly confirmed his statements, having known the boy and his family, who belonged to that class known to us as "poor white trash." Heredity played no part in this case; his family was in fairly good health, yet probably the home was a hot-bed for hookworm. This patient's health had never been good; he evidently had suffered from the infection of hookworm since he had the "ground-itch," years ago. He had gone to school occasionally until his sight began to fail and he spent that year "around the house" because "shortness of breath" kept him from working. His appearance was so typical of hookworm disease that it was of no credit to the microscope to find the eggs later. He was small in stature, about 4 feet 6 inches, very pale, having a bloated face, an anxious expression, and the tissues relaxed, and he gave the appearance of not being more than 12 or 15 years old, and the mind of one not that age.

Examination.—The conjunctiva was bloodless, the pupils reacted to light, and the projection was good. After dilating the pupils, I found a fully developed cataract in the left eye, the right not quite as mature. I sent the patient to the hospital to be operated on the next day. Except for a hemic murmur he was found to be normal by a physical examination. The urinalysis was normal. Blood showed hemoglobin 20 per cent.; red cells 2,000,000. The feces were loaded with eggs of uncinaria.

Operation and Other Treatment—Under cocain anesthesia a light discission of the left cataract was performed and in two days I found absolutely no reaction either of the globe or lens. Four days later I attempted another discission, lacerating the capsule well and stirring up some of the cortical substance of the lens. Much to my surprise, I still found no reaction to the eye or swelling of the lens. Then I deemed it best to give the patient the usual preparation and treatment of calomel and thymol for such parasites, and saving all stools after the administration of thymol, 750 worms were found. Within a few days after the treatment the lens commenced to swell, although it took six discissions in each eye to establish an opening through the dense capsule which remained clear and through which the fundus could be seen. After four months of careful nursing and treatment at the Wesley Memorial Hospital, glasses were adjusted and with his left eye he could see 20/70 with a + 11.50 S. The result in his right eye was not so good at that time, as there was an unabsorbed capsule. A very good view of the left fundus was obtained and I found marked circulatory disturbances in the retina. The nerve head was swollen two or three diopters, the veins markedly dilated and throughout the retina there were a few small flame-like hemorrhages. These retinal disturbances were undoubtedly the cause of the poor sight after the operation, as the pupil was large and black and the media clear.

Course.—In a letter six months later the patient tells me that his sight is still improving, meaning that, as his anemia vanishes, the retinal congestion diminishes and sight is restored. Unfortunately no accurate records of weight or height were taken but he must have grown 2 inches, and gained 30 pounds from July 4 to November 26. The hemic murmur disappeared, his mind grew brighter and he was full of energy when leaving, although the thought of home and the approaching of Christmas time acted somewhat as a stimulus.

September, 1911, the patient returned for examination. He had gained in weight, and his color was very much improved. With the proper glass, vision was improved to 20/20 in the left eye. The engorged and tortuous veins had been reduced to normal. There was no swelling of the nerve or retina, and there existed the merest trace of any retinal hemorrhage. There was still some capsule in the right eye and after a capsulotomy, he had 20/70 vision. No fundus-changes were observed in this eye.

CASE 2.—This case is not so interesting, but I am convinced that the anemia and toxemia produced by the hookworm caused the cataracts.

History.—L. B. C., aged 26, of Newnan, had been blind in the right eye for two years; in the left for ten years, whereas up to that time when out hunting, as he expressed it, "he could kill a rabbit as far off as any one." His father, an old man, had cataracts removed some years ago, a record of which I have. He gives a history of having had the "ground-itch," for which he was given some sort of treatment years ago, and of having been thin and puny when a boy. This treatment possibly was the thymol treatment for hookworm, although I have been unable to learn anything definite from his family on this subject. This patient was well-developed (another fact which makes me believe that thymol has at some time been administered), but he had the appearance of a boy 17 to 20 years old, and the intellect of one much younger, although he was thoroughly ignorant and had never been to school.

Examination—The right eye showed an immature cataract of the cortical variety; as to vision, patient could count fingers at a distance of 4 feet. Left mature cataract. Projection good in each eye. Blood normal. Urine normal. Feces: many eggs of uncinaria.

First Operation.—On account of no existing anemia, I decided to operate before giving him the thymol, in order to save time, and on September 11 the lens was extracted *in toto* from the left eye, after the Graefe method. Healing was uneventful and on the 27th the treatment for the hookworm was given and about 200 parasites were found. Later a glass was prescribed for his left eye and only fair vision was obtained, viz., 20/100, explained only by the fact that the

12. Dock and Bass: Hookworm Disease, St. Louis, 1910.
13. Calhoun, A. W.: Ophth. Rec., 1904, xii, No. 7.
14. Calhoun, F. P.: Ophthalmology, September, 1911, xxviii, No. 9. Tr. Oph., xxviii, No. 11.

eye was amblyopic ex anopsia for ten years. Only a preliminary iridectomy was performed in the right eye and I anticipate a much better result after extraction.

Second Operation.—April 15, 1911, the patient returned by request for the second operation. The right cataract was extracted after a preliminary iridectomy, and the result was fair, namely 20/200 vision. The fundus appeared normal. The fact that the vision after the operation was approximately the same in each eye makes me now doubt my former opinion, that the left eye was amblyopic ex anopsia. The vision in the left eye, nine months after the operation, was 20/50, and as the fundus still shows no alteration, I am rather inclined to believe that a toxic neuritis existed then, which passed away after instituting treatment.

CASE 3.—*History.*—P. B., aged 22, from southern Georgia, was referred to me by Dr. A. G. Fort, field agent of the Hookworm Commission in Georgia. I am indebted to him for the case, and the family history of the patient. The family consists of a poorly nourished, hump-back father, a mother and nine children, who up to a short time ago lived in the backwoods of southern Georgia, running a small farm. All the children when old enough worked in the field or helped around the house. They went barefooted most of the year. There were no out-houses or privies on the place. Seven members of the family, including the father, were examined by Dr. Fort, or his assistants, and found to be infected with hookworm. This patient had been sickly all his life and, to use his expressions, he had "heart dropsy" up to three years ago, when he had taken some medicine and since that time he had "picked up right sharp." He had gone to school to some extent, until his sight began to fail ten years ago. Questioned as to his sight before that time, he said that he knew it was good. Sight first failed in the left eye, which rapidly went blind, and five months later the right began to be slightly affected. Since March, 1911, the boy has been a pauper on his county, although he is very energetic and exceptionally bright for a hookworm subject or a backwoodsman. He is quite thin with drawn features.

Examination.—This was negative. Blood showed hemoglobin 75 per cent.; white and red cells normal; urine normal; feces contained no hookworm eggs (the patient had received treatment). Eye examination: With the right eye the patient could count fingers at a distance of 3 feet; the pupil was dilated, and sector-shaped opacities were seen at periphery of lens, with dense changes in the posterior cortex. Left eye had light perception only, which was good. Lens examination was made after a mydriatic, and there was a chalky white cataract with evidences of some cortical absorption. The capsule was thickened near the anterior pole.

Operations.—A very light discission of the right lens was done at the same time and a thorough stirring up of the small amount of the soft cortex in the left eye. A week later a second discission was made in the right lens, as little reaction had developed. The left eye was doing nicely.

Course.—In all six discissions have been performed on the right eye and three on the left, and the patient is still confined to the hospital at the time of this writing, eight weeks after the first operation. The right cataract is absorbing slowly, while the left has almost entirely cleared, and with the correct glass his vision is 20/70. The fundus appears normal.

My fourth case, a most unusual one, was that of spontaneous hemorrhage from the conjunctiva of one eye.

CASE 4.—*History.*—In the spring of 1911 a well-developed girl, aged 11, was brought to me from Florida on account of bad sight in the right eye, but principally because there were periodic attacks of spontaneous hemorrhages from that eye. I had some correspondence some weeks previously with the child's mother, who wrote that frequently since December, 1910, she had observed blood on the right side of the girl's pillow-slip in the morning and occasionally some dried blood on the eye lashes. I advised her to bring her daughter to Atlanta for examination.

Examination.—March 13, 1911, I found vision, right-hand movement only. There were old nebulous corneal scars from attacks of "sore eyes" two years previously. Vision left 20/20. The mother stated that the child's health was not good, and she "bloated" and her feet swelled. The menstrual flow was not yet established; the child was quite stupid. The pupils were dilated for retinoscopy. The right was unimproved, retinoscopy +4 S; left 20/20 with +1 S. Fundus, right, papilla very much swollen, outline very indistinct, vein tortuous and dilated, no hemorrhages. Left negative.

Treatment.—As soon as I saw the right fundus I recalled the picture of hookworm cataract (Case 1), and suggested a laboratory examination of stools. This was made with a report of "many eggs." Appropriate treatment was suggested and carried out by the family physician at home; + 75 S were prescribed for constant wear, and the patient immediately returned to Florida. I observed no hemorrhages from the eye at this visit.

Course.—Within a few days after leaving, the mother wrote that the patient had had a severe hemorrhage from the right eye. I suggested that she make another visit to Atlanta as soon as possible, and come with the understanding of remaining as long as necessary. On April 24 she returned with a letter from her physician, who wrote that calomel, salts and thymol had been given, and a quantity of worms had been expelled. A second stool examination was made in Atlanta. Very few eggs were found and the thymol treatment was repeated. The eyes were again examined under a mydriatic. The vision of the right eye was the same, namely, hand movement only. The vessel was not so large and the papillæ not so swollen; vision on the left with glasses, 20/20.

The mother stated that no hemorrhage had been observed in four days. I gave her instructions to call me, day or night, when hemorrhages occurred. Three days later I received a telephone message early one morning before office hours that there was some slight hemorrhage. The patient was brought to my office without having her face washed and I found dried blood on the lashes. The conjunctiva of the globe and of lower lid was normal, but on inverting the upper lid, in the retrotarsal fold, I observed some dilated veins. This evidently was the one point from which all hemorrhages came and the tears forming washed the blood from the lashes. The patient was given an iron tonic, a weak epinephrin eye-wash and observed for several days afterward. A letter from the mother, October, 1911, informed me that there has been no subsequent hemorrhage. The sight in the right eye has been much improved, and she thinks that her general condition is better.

Lutz's cases of chemosis of the bulbopalpebral fold are the nearest approach to this phenomenon that I can find.

Having the facts before us, that eye-changes do occur in individuals who are infected with hookworm disease, and these changes have been accurately and minutely described by men of prominence, it might be of interest to those who are not familiar with the clinical picture of this disease, for me to mention briefly what hookworm is, the pathology, the mode of infection, the symptoms, the treatment, etc., and then draw the conclusions.

Hookworm disease is due to certain species of hookworm which live as parasites in the small intestine. It occurs especially in warm countries or in temperate latitudes where the climate in summer, or other conditions (as warm mines), offer favorable conditions (Dock).

For many centuries this disease has been known to occur in the Old World, and Stiles quotes Joseph Pitt (1808) as the earliest American author to mention it. Of the many later workers in this disease, Smith and Schaeffer of Texas, Smith and Harris of Georgia, and Stiles, of the government service, stand prominent as pioneers in the discovery of hookworm disease in the South.

Hookworm affects those who have intimate relations to the soil and the poor country people of the South without the proper knowledge of cleanliness or hygienic surroundings are the ones most commonly and seriously affected.

The mode of infection may be by any one of many ways, that is, by food, water, or through the skin. Dock mentions that skin infection is practically the only source of the disease.

The worms reaching the adult life, or the stage of reproduction in the small intestine of man, lay eggs which pass out with the feces. The eggs do not hatch in the intestines on account of lack of oxygen and other reasons. For that reason one cannot infect oneself. These larvæ are not infectious until they are 4 or 5 days old, then they may penetrate the skin, reaching the venous circulation, going to the heart, thence to the lungs and bronchi, and are carried to the mouth by the normal outward current of the bronchial mucous membrane and by coughing, and are finally swallowed.

When the larvæ penetrate the skin a dermatitis is produced, and in bare-footed children this dermatitis produces a common early symptom known as "ground-itch."

The symptomatology of hookworm disease is most variable, in fact, there are a great many cases which present no symptoms that can be recognized as variations beyond normal. Anemia, of a most pernicious type, with variations in hemoglobin estimate, as low as 8 per cent., is the predominating symptom; along with this severe anemia, albuminuria, dropsy, weakness, pallor, incapacity for any work, shortness of breath, etc. Death may intervene, as the patient's resistance is so lowered that he quickly succumbs to any intercurrent disease. In another type, not so severe, the hemoglobin is 50 to 70 per cent., lowered vitality and energy, dizziness, symptoms of dyspepsia, etc. Children with this type do not develop in mind and body. The individual may be 20 to 25 years of age, whereas he is no larger than a child 10 to 12 years of age.

"The diagnosis is to suspect its presence" (Manson). The microscope will find the eggs in the stools if they are present. The treatment consists of the administration of calomel or oil as a purge, followed later by a saline, and then the anthelmintic (thymol) in doses to 60 grains; finally another saline to cleanse the bowels of the dead worms.

Toxic amblyopia from thymol has been observed by Farrel, of the North Carolina Hookworm Commission. He could not tell me whether it was temporary or permanent. It had occurred twice in 28,000 cases and Nieden mentions amblyopia, temporary or permanent, from ½ to 2½ drams of extract of filicis maris (male-fern).

That there is a toxin produced by hookworm disease, most students of the disease agree. What part is played in the causation of the symptoms, that is, the destruction of the blood or the eosinophilia, I dare not venture an opinion. I might say, however, that there are cases of hookworm infection with a severe anemia in which few worms are found. This alone would strongly point to a toxic action in the blood. It is Ashford's belief that a "toxin" exists.

Does hookworm disease cause eye-changes or are they merely associations? I firmly believe in the affirmative and it is my purpose to prove the assertion.

Retinal hemorrhages, enlarged veins and a neuritis strongly point to a toxemia, producing a degeneration in the fundus. Neiden thinks that the great loss of blood through the blood-sucking worms is a doubtful cause; in cancerous cachexia, there is often produced a fatty degeneration of the retinal fibers as well as circulatory disturbances of the same. These he described to be the toxins, produced by the tumor.

Fischer[8] is of the opinion that the eye-changes are due to toxins.

As to certain circulatory disturbances of the retina, and even the case which I report of spontaneous conjunctival hemorrhage, I do not believe that anyone would doubt that hookworm infection produces them through the medium of a toxemia; but whether the disease would produce cataracts, there has been extreme doubt, regardless of my decided views.

In the consideration of the etiology of hookworm cataracts, I would call attention to certain well-known anatomic and pathologic facts.

1. The lens receives its nourishment from its surrounding liquids—the vitreous and mainly the aqueous—by diffusion through the lens capsule. That metabolism in the lens is slow is proved by the fact that lens opacities often remain stationary for a long time.

2. The lens proper is protected from the aqueous by its capsular epithelium. Hence any disturbances to this capsule will cause cloudiness in the lens sooner or later.

3. An alteration in the composition of the aqueous, e. g., poisonous substances or toxins, exerts changes on the epithelium which in turn cause a cloudiness in the lens; or more directly, as a result of diosmosis, through the intact lens capsule these poisons produce opacities.

Such an alteration has long been considered as a possible cause for senile cataract, due to some senile change in the ciliary processes which secrete the aqueous (Peters), or to certain disturbances in the general metabolism, as occurring in chronic nephritis.

Additional evidence that toxins do produce changes in the capsular epithelium is that rare form of anterior polar cataract due to deep non-perforating ulcers of the cornea.

4. The foregoing changes are presented to us in the form of complicated cataracts, occurring secondary to changes of the inner coats, or even a more beautiful example is the naphthalinic cataract. The experiment was first performed on rabbits by Bouchard; when naphthalin was administered there developed a retinitis with vitreous opacities, and a cataract subsequently formed. In man this phenomenon has been seen to occur when a naphthol ointment was used for skin diseases.

5. Other systemic diseases as cholera and pellagra, similar to uncinariasis in that they produce toxins and to an extent an anemia, cause cataracts.

In many respects hookworm disease is similar to pellagra. It is a systemic disease, the cause of which is still obscure; this disease produces toxins; and that there are eye complications, notably cataracts, caused from these circulating poisons, is an established fact known for many years.

Stewart Roberts, of Atlanta, in the latest works on pellagra, devotes considerable space to eye complications. As to the formation of cataracts he quotes Fabricious and Procopui, who show that cataracts are of unusual frequency among pellagrins, even pellagrous children develop them in the form of milky cataracts. Welton, in reporting his investigation in Peoria, refers to the frequency of early-forming cataracts, and Tucker found cataracts in three out of forty-five cases, while Whaley, of South Carolina, found cataracts in six out of thirty-

five pellagrins. Roberts attributes the cataract formation to the metabolic degeneracy of the entire system, the altered and lowered nutrition of the lens, as determined by the presence of the pellagra poisons.

Why, then, not cataracts in hookworm disease?

Frenkel,[15] of Toulouse, in his study of the pathogeny of the lens, states that different body toxins produce changes in the ciliary zone, which also produce changes in the lens.

In very recent letters from Lippitt, of San Juan, he gives me histories of two cases of cataract in young hookworm subjects; one a negro, aged 20, with a well-advanced cataract in one eye and one beginning in the other; the other a 13-year-old girl with a commencing cataract in both eyes. She presented no other symptom of anemia. It is Lippitt's opinion that the production of cataract in early life proves the existence of a toxemia in hookworm disease.

It is interesting in this connection to know that while the negro may be infected with hookworm, uncinariasis does not produce anemia. Such is the experience of Lippitt and Ashford in Porto Rico. I have never seen a negro hookworm patient, and they are extremely rare.

Finally, having in mind the anatomic situation of the lens, its nutritive dependence on the ciliary zone and its neighboring fluids, and an alteration in these structures, whether from an anemia or an accumulation of toxins (or both), I believe them sufficient to produce cataractous changes.

If hookworm disease does produce cataracts, then we have a new cause, and one which can be prevented.

I am indebted to the gentlemen who have aided me with their courteous and interesting letters; especially I wish to thank Drs. Fort and Roberts of Atlanta and Dr. Ablemann of Washington, D. C., for their many suggestions and their help in the preparation of this paper.

833 Candler Building.

ABSTRACT OF DISCUSSION

DR. HOWARD F. HANSELL, Philadelphia: The only case I ever saw was that alluded to by Dr. Calhoun, published in the *Transactions of the American Ophthalmological Society*, 1901. The patient was an Italian boy, aged 16, who had been brought into the medical wards of the Philadelphia General Hospital from an immigrant ship which had sailed from Mediterranean ports. His case was diagnosed as pernicious anemia, and it was only after a thorough examination of all the bodily organs and secretions that the cause of the anemia was suspected. The ocular findings were those described by Dr. Calhoun—moderate double optic neuritis, edema of the adjacent retinas and numerous hemorrhages scattered throughout the retinas. The vision was for a time seriously compromised. After the discovery of the intestinal parasite suitable remedies were administered, and the patient recovered his vision and his health. I have no doubt that a considerable proportion of cases of anemia classified as "pernicious" owe their origin to the *Ankylostoma duodenale*. A study of this affection and a wide-spread dissemination of the knowledge gained has resulted and will continue to result in the saving of many lives. I fully agree that hookworm disease may be the cause of cataract. We know in part the etiology of cataract, but we do not know it in full. The presentation of these cases carefully studied seems to point to a new factor in the etiology. We can hardly accept the conclusion that anemia alone is responsible, for we have but to remember the many cases of anemics that we have seen who have clear lenses. The excessively high degree of anemia associated with hookworm disease or the toxins of the worm, preferably the latter, certainly point to the justness of Dr. Calhoun's conclusions.

15. Frenkel: (Ann. de l'oculistique, February and March, 1910).

THE DANGERS TO AND THE REQUIREMENTS OF THE EYES OF THE NATIONAL MARKSMAN

JOHN A. DONOVAN, M.D.
BUTTE, MONT.

The time has come when the efficiency of our army and navy depends on our marksmanship. Since Congress authorized the sale of small arms to any citizen affiliated with the National Rifle Association, everywhere an increasing interest is taken in this line of sport. Even our high schools are producing many expert marksmen.

In 1903, of 18,325 men firing the prescribed course in our army, but 907 qualified; while in 1909, of the 27,121 men trying, 2,065 qualified as experts, 6,026 as sharpshooters and 2,945 as marksmen, or a total of 11,036 compared with the 907 six years previously. Of the 10,000 men firing in the navy in 1906, only thirty-six qualified; whereas in 1909, 999 qualified. The Marine Corps report shows 107 having qualified in 1906. At the close of 1910, 3,878 had qualified, of which 555 are experts.[1]

Has the oculist kept pace with the increasing demands for his assistance with this work? The efficiency of our present military rifle is limited only by the ability of the man behind the gun, and the limitation of his vision is about the only restriction so far not overcome. The sporting magazines, I fear, are in the lead in the discussions of the requirements of the marksman's eyes and the suggestion of remedies.

At present, the official bull's-eye at both 200 and 300 yards is 8 inches in diameter, the shooter standing for the former and kneeling or sitting for the latter. All other ranges are shot from the prone position, i. e., the shooter lying flat on the ground, head toward the target. Twenty inches is the size of bull's-eye at 500 and 600 yards, and for the expert who shoots the extreme ranges of 800 to 1,000 yards, 36-inch bull's-eye is used.

Using Snellen's standard at an angle of 1′ we get a little more than 1 inch for each 100 yards. Thus the 8-inch at 200 = an angle of 4′, the same at 300 yards = 2.66′, 20-inch at 500 = 4′, at 600 = 3.33′, the 36-inch bull at 800 = 4.5′; at 1,000 yards it is 3.6′. From this it is easy to calculate the visual requirements from Snellen's test-letters that will enable a man to see a bull's-eye distinctly at 1,000 yards, providing atmospheric conditions are correct. But as a bull's-eye is round — therefore a spot — and the distinctness of a spot depends rather on its illumination than its size, the color contrast, light and atmosphere must be considered in the test. Reflections from the white ground, sand or water, bright sky, sun in eyes, etc., may make the target invisible. How to overcome these obstacles is the oculist's problem. The shooter must elevate his sights, should the target suddenly become clouded, and vice versa, should it become bright. A glass that would maintain a more uniform light would largely obviate this and produce more accurate results.

The expert marksman to-day must be a scientist, understand the laws of internal and external ballistics, the effects of wind, temperature, light, mirage, barometer, hydrometer on the elevation and deflection of each shot fired. In addition to this, according to the visual law of 1′ angle an error of 10 inches in the 1,000 yards is to be allowed for. At 500 yards distance, a 6-foot man would be seen at an angle of 13′44″, or 2.7

1. Official Report of Rifle Shooting in the United States, 1910.

times Snellen's requirements. At this standard, if it were not for the obstruction of the atmosphere, a man could be discerned at 1,375 yards.[2]

Our military rifle, new Springfield model, 1903, using 1906 ammunition, 150-gr. bullet, velocity, 2,700 foot-seconds, is very accurate and effective at any of these ranges. In fact, is sighted up to 2,800 yards. The sights are 22.1254 inches apart and a movement of the rear sight 1-150 inch = 1′ sight radius, which moves the bullet 1 inch on target for each 100 yards. Though 1-150 inch in movement is necessary for extreme accuracy, the unaided eye can discern but 1-100 inch.[3]

Our patients ask for glasses to see rear sight, front sight and target all at one time, and usually attribute the defect in shooting to old age. What can be done?

The rear sight when held close is 9¼ inches from the eye when firing, requiring 4.33 D. S. accommodation. The front sight 32 inches requires but 1.25 D. S. accommodation, while the target requires none if the eye is emmetropic. One theory, as taught by Surgeon-General Longmore, C. B.,[4] is that an alteration of accommodation takes place in rapid succession in shooting. Bouchart[5] gives credit to Sulzer for solving the problem by the theory of the continuation of retinal impressions (6/100 of a second) gained by seeing each sight and the target separately. To add to this, he shows that the time necessary to send impressions of objects to the brain is augmented with the distance. This theory has much in its favor and seems to have gained many adherents among us. The length of a retinal impression depends on the illumination and size of the object. On the other hand, Grecner, a British expert,[6] says: "The sights, both being out of focus, will be to some extent blurred and must therefore be of shape and color best adapted to impress the eye directed on the target." Dr. W. G. Hudson, one of the world's best experts,[7] says:

> If the eye is focused on the bull's-eye, the rear sight will be blurred very much, and perhaps the front sight may blur a trifle, but not sufficient to make it indistinct. Therefore, all that is necessary is to be certain that we see top of front sight through center of aperture, and after that we may disregard rear sight.

Our War Department, in the books of instructions,[8, 9] recognizes the same facts. Their advice is to look at what one is shooting and not think of the sights. I have tested this theory by suspending my accommodation with homatropin, being then able to make the same scores. With accommodation fully paralyzed, distant vision was reduced to 20/70, yet through the rear aperature sight on a Springfield I could read 20/15. Wearing correction for the hyperopia, the rear sight was a complete blur, the front sight indistinct, yet in five scores at 200 yards my results equaled my average. Lieut. T. Whelen, U. S. A.,[10] says:

> Some men have difficulty in seeing the bull's-eye distinctly when aiming. It may appear gray and blurred. In this case center the bull's-eye in the peepsight, instead of the front sight, bringing the front sight to its correct position relative to the bull's-eye.

Experience has shown that those who shoot with both eyes open have much less strain on the eyes and can maintain a clear bull's-eye which otherwise would become blurred.

The best argument in favor of the theory of the necessity of accommodation in focusing the sights instead of the target is made in an excellent article by Maj. Henry A. Shaw, Surgeon United States Army, and Lieut. Col. J. M. Banister, Department of Surgeon-General, United States Army.[11] They quote several noted authorities, and with ten sharp shooters made many careful tests, firing five shots each with naked eye, five each with vision blurred by + lenses to make it 20/40, and five each vision blurred to 20/70. The results showed equally good. From this, they prove that an accurate focus of the sights only is necessary. They do not take into account that once the expert finds the bull's-eye and is holding good, he can make each successive shot come near the other as long as he retains his fixed position. Nor do they consider that the bull's-eye is a spot; thus its distinctness depends on its illumination, and the law applicable to Snellen's test-type would not bear the exact relation. Above I have shown that the bull's-eye has sufficient size to be easily discernible by a man with at least one-third normal vision. In fact, all that such a test really did accomplish was equivalent to shooting at a poorly colored target or in a bad light, which, as a matter of choice, no man would make. If accommodation is necessary, why do we find it so much less tiresome and the bull's-eye often more distinct when both eyes are kept open? If we are using accommodation, then we must suspend our convergence. Why does a sportsman choose the aperture and gold bead for use in the woods, if the main part of his vision is to be centered on his sights? On seeing his game, he glances through the rear sight simply to bring it into position, then at the front sight to know the general position of his rifle, and then, watching the game until he notices that the sights come perfectly into his line of vision, he fires. The first two movements, made to bring the gun into line, become unnecessary with long practice. The only requirement is to have sights distinct enough to produce a definite retinal impression once they come into perfect alignment with the object. The snap shooter becomes unconscious of his sights.

The full correction for distance is therefore the glass to be prescribed. For the presbyope, the bifocal is the ideal combination. For defective vision, the rear sight in all cases should be an aperture close to the eye, which is practically the same and gives the same result as the stenopaic disk in our trial case. It should be small enough to admit only the rays the eye can focus, but must be large enough to admit sufficient light to see the object clearly; thus, an extra size is necessary for use in a poor light. Our present military sight is unnecessarily far from the eye, making the very admirable aperture sight in it often impracticable. A new receiver sight, approved by some expert riflemen, is now on the market, and it is hoped the War Department will at least permit its substitution, as it will be of great assistance to all with any visual defects. The front sight for these persons should be sufficiently large that its top may be plainly seen when the eye is focused on the bull's-eye. The improved scores made with the new sights of this class on the Ross rifle (Canadian) prove their advantages. The use of the ophthalmoscope with suspended accommodation will fully explain the correctness of these statements.

2. British Optical Manual, 1885.
3. Suggestions to Military Riflemen, p. 86.
4. Optical Handbook of Instructions, British Army, Ed. 3, p. 14.
5. Wood and Andrews: Practical Medical Series, 1906, II, 29.
6. Sharp Shooting for Sport and War, Ed. 2, p. 172.
7. Modern Rifle Shooting from American Standpoint, p. 67.
8. Small Arms Firing Manual, 1909, p. 30.
9. Manual for Privates of Infantry, 1909, p. 26.
10. Suggestions to Military Riflemen, p. 67.
11. Circular No. 5, War Department, Jan. 25, 1908.

In putting on the correcting lens, whenever possible, the final test, if lenses are at all strong, should be made with the trial frame on and properly adjusted while in firing position. Nearly all shooters look either through the upper edge or over the ordinary glasses, thus making them useless or worse, by producing diplopia. The center of the lens to be used for shooting only, should be decentered up about 1 or 2 cm. and at least 1 cm. in. The lenses must set up very high, toric shape and if possible away from the brow, to prevent blur from sweating. The navy team for match work had the bottoms cut off the lenses to allow the bolt to be withdrawn without hitting the glass.

To protect the eyes from the glare and maintain a more uniform light, a light amber has been adopted by sportsmen. Experience has been their guide.[12] Parsons,[13] before this Section two years ago, suggested that we were not so well informed as we should be on the effects of light and colored lenses. Judging from the many conflicting reports on the advantages of different-colored lenses, we may still learn much. If didymium glass, which he suggests, being colorless, has proved its efficiency, it would have every advantage. Amber, euphos (greenish-yellow imported glass), etc., all absorb much light. The sportsman is awaiting our conclusions. Something is necessary, more especially for the indoor range work, in which electric lighting is used. Artificial light is prescribed. The 10-spot is the inner ½-inch circle in a 1½-inch bull's-eye at 25 yards. For occasional shooting, this is not annoying; if one keeps at it long, the eyes give out. I have tried several tints of amber, euphos and amethyst lenses and find that all absorb considerable of the light, but the eyes in time fatigue so the black spot becomes gray and may entirely disappear. In careful shooting, the eye is kept on the bull's-eye, steady pressure being made on the trigger until the front sight appears exactly under the center of the lower edge. My observation in the team which for two years held the championship in this indoor shooting was that long before the season closed, every man complained of exhausted vision, and this year, owing to the severe eye-strain experienced, four of the five were unwilling to enter another long contest.

A mark made with a pencil is in the proportion of 80 per cent. to one made with ordinary ink; therefore, a standard jet-black should be adopted. A mercury vapor lamp with glass, not quartz, the irritating rays being absorbed by the glass, is possibly the proper illumination, and I have recommended it to the local team, but so far we have not used it.

The use of large glasses, instead of being discouraged should be encouraged, not only to relieve the strain from refractive errors and light, but also as a protection. Accidents from shooting a modern rifle, with our present high grade of ammunition, are usually from small specks entering the eye, which large glasses would prevent. With 0.22 caliber rifles, we frequently get powder burns from back fire, resulting from either overtempered shells or overloaded ones, or a piece of shell may blow back. This unfortunately occurs in many of our best 0.22 rifles of present make. I have seen many bad results from shells, whole or part being thrown into the eye by back fire or the extractor. This is more likely to happen to any person standing at the side and to the front of the shooter. Pieces of lead may fly off between the cylinder and barrel of a revolver. Another danger, likely to occur to one standing in front and to side of line of fire, is that pieces of metal fouling or splinters from a poor bullet may fly off from the line of aim. I do not consider the "didn't know it was loaded" accident or the direct effects of a bullet, as these are governed entirely by the law of consequences.

In conclusion, the eyes of the expert rifleman require the greatest care. Full correcting lenses should be not only allowed, but constantly worn. They must be made high enough, in far enough and large enough so that when the head is down and the eye looking upward to almost its limit, vision will be distinct through the glass. The cylinder, if strong, must be rotated in the trial frame, with the head in the firing position, to determine that vertical lines appear as such with the glasses on; otherwise, the rifle will be canted and will shoot to one side. A toric lens is necessary, and for shooting in bright lights or artificial lights, a light amber or some other color is essential. For presbyopia, bifocals are preferable or a pocket lens should be carried to adjust the sights and do other near work. The front sight should be large enough and of color contrasting to the target, to be clearly discernible to the emmetropic eye without accommodation. The rear sight should be close to the eye and of such a size and shape that the light, being best through its center, the eye will naturally see the tip of the front sight through the center of the rear without accommodating, while vision is being centered on the target. Finally, to the ametrope, large tinted lenses, properly correcting the ametropia and snugly fitting, will more than compensate the soldier in relief from fatigue, and in the protection of his eyes from accidents, for all the disadvantages at present urged against them. The frame should be of stiff material, solid temples with soft ear pieces.

The present visual requirements are:

Second lieutenant in coast artillery corps, 20/40 either eye and good color vision. (General Orders 65, 1911.)

Second lieutenant in cavalry, field artillery and infantry, 20/40 each eye and good color vision. (General Orders 131, 1911.)

Second lieutenant in corps of engineers, same requirements. (General Orders 139, 1911.)

Officers of army for promotion — defects of vision entirely corrected by glasses do not disqualify unless due to, or accompanied by, organic disease. (General Orders 192, 1909.)

Medical corps—must be not less than 20/100 and not below 20/20 each eye with glass. (General Orders 112, August, 1911.)

Recruits for army and signal corps—20/40 right eye; 20/100 left eye; Ordnance Department and Hospital Corps—20/70 each eye, correctible to 20/40. (Circular 26, 1909.)

All of these requirements appear to be very reasonable.

723 West Park Street.

12. E. C. Crossman, F. W. King and others in sporting magazines.
13. Parsons, J. H.: THE JOURNAL A. M. A., Dec. 10, 1910, p. 2027.

ABSTRACT OF DISCUSSION

MAJOR P. S. HALLORAN, U. S. A.: There are one or two additional reasons for the increase in the number of marksmen in the services of the United States. In the Navy, the gun-pointer, who is the most important man in firing, is required to have perfect vision, 20/15. That policy has been adopted in recent years, and is one feature which accounts for the increased average in the Navy. In 1908 the pay of the soldier was increased for proficiency in shooting. A man qualifying as expert receives $5 a month additional, while sharpshooters and marksmen receive $3 and $2, respectively. This is quite an incentive to increased proficiency in shooting.

I am not in sympathy with the views of Colonel Banister and Major Shaw in that it is not necessary to have a clear vision of the target. I have talked with many expert shots of the service, and they are all of the opinion that one must have a clear view of the target.

The experiments conducted by these officers were with men who were good shots and, almost by intuition, due to their experience, they made nearly as good scores when their vision was reduced. It is doubtful if a man with defective vision can ever become an expert marksman. Focusing on the target is essential. This is illustrated in trap shooting—the man does not see his sights, but he does have a clear view of his target.

DR. ARTHUR G. BENNETT, Buffalo, N. Y.: I have had experience in fitting distinguishing marksmen, because near Buffalo there is a rifle range where the experts go for their competition. My experience with them has been that their shooting falls down about the age of presbyopia. I had a shooting contest with a friend, who was myopic; his best vision was 20/100. He shot without glasses, but he had a good view of the rear sight, which I did not have. His myopia was of the simple form that gave a blurred image of the target, but it was increased in size, and he could estimate it closer than I. With that theory in view, I fitted a number of marksmen at Niagara with a focus a few inches beyond the rear sight, and their testimony is that their shooting has come up to the standard that it was before they obtained the glasses. They are satisfied and have referred patients to me from different parts of the United States, and with them I have followed out the same plan with a good deal of success. The focus is about 3 inches in front of the rear sight. It does not give them the sharpest view of the rear sight or quite such a blurred view of the foresight. The target itself is a blur, but is increased in size, and their shooting average has certainly pleased them.

DR. W. C. POSEY, Philadelphia: My own views are in accord with those expressed by Dr. Donovan and Major Halloran, as I believe it should be the aim of the ophthalmologist to correct the eyes of the marksmen with the best degree of acuity possible for the target. In actual warfare, I think it would be ludicrous to send out sharpshooters to pick off the enemy with their vision focused by glasses to 3 inches beyond the rear sight. As a member of a commission appointed from the Medical Reserve Corps by the Surgeon-General of the Army some years ago to prepare a new standard of visual acuity, I was impressed with the little vision required by ordinary troops, nearly all of the firing being done in volleys at the command of the officers, without any attempt at sighting at the enemy. A vision of 20/40 in the best eye seemed to be perfectly adequate for all purposes. I found that many marksmen of note had relinquished an amber tint in their glasses, because they found it did away with the "mirage," the term they employ to designate the atmospheric effect by which they judge of the direction and velocity of the wind, etc. The euphos tint had been given up for the same reason. Dr. Donovan's suggestion that the glasses should be set at some distance from the eyes, in order to avoid the moistening of the lenses by perspiration in field practice, where the men perspire freely and must throw themselves quickly into a prone position, is a good one. The removal of the lower half of the lenses possesses certain technical advantages.

DR. ALEXANDER DUANE, New York: I am inclined to agree with those who express the opinion that sharp vision is necessary for long-range shooting. We do not need to see the object aimed at distinctly. My own personal experience is that with uncorrected vision of 20/40 in the sighting eye, such as I have, I could see well enough at 200 or 300 yards, but when I attempted to qualify at 500 yards as a sharpshooter I could not see the bull's eye well enough to get my eye on it, and I made no success at all as a marksman. I am inclined to agree with the view of Dr. O'Connor, who studied the subject carefully and gathered the opinions of experts in the Army. Like him, I believe that we really do need sharp sight in the Army, such as is required in the Navy. In the Navy they require for ordinary seamen 20/20 and for gun-pointers 20/15, uncorrected vision.

DR. S. D. RISLEY, Philadelphia: So far as my personal experience goes, both in target practice and in shooting at birds, sharp sight for the object aimed at is essential. I am sure I always regard first the target or bird, and simply gazing through the sight, uncovered the object, getting a clear view of it. Among my friends who are fond of marksmanship, two are very highly myopic and always used their glasses. As marksmen they stand within the first five in the 100 for marksmanship. One said: "My glasses minify the object and when I see it I have it down fine." So that these two men certainly depended on sharp sight for the object itself and not for the near sight. I am sure that this agrees with my own personal experience.

DR. JOHN A. DONOVAN, Butte, Mont.: We cannot draw very definite conclusions from one individual with myopia. A myope becomes accustomed to a blurred object which to him appears normal. A good shot, in practice, will make much better scores on a blurred target than others can under more favorable conditions. Most Americans are hyperopic and I am inclined to believe our first correction of presbyopia is really correcting the latent hyperopia, which accounts for the better scores obtained with these glasses.

THE FINDINGS OF THE TROPOMETER IN 100 NORMAL EYES AND ITS VALUE IN THE STUDY OF STRABISMUS

WENDELL REBER, M.D.
PHILADELPHIA

Despite the fact that it is twenty-two years since Stevens introduced his tropometer to the profession (1890), it must be admitted that the instrument has not come into what might be called popular use. It is true that Nicati eighteen years earlier adapted the ordinary perimeter to the rough estimation of the rotational power of the eyes; but to Stevens must belong the credit of devising a thoroughly practical instrument of sufficient mechanical convenience and scientific accuracy to justify its every-day use in ophthalmic practice. To maintain that it is without its limitations would be absurd; and to claim that it is without practical advantages is equally at variance with the facts. The truth, as is usual, is likely to be found midway between these two extremes.

There are many ways of estimating the rotational powers of the eyes, all of more or less use. Casey Wood's method of using words of two letters to be carried as far out on the inside of the arc of the perimeter as they can be read is well known and among the most practical and useful of all the perimeter methods. It is a subjective method and, in patients of average or more than average intelligence, a valuable test. Dr. Wood has modified this method somewhat as is shown in the following letter:

My dear Dr. Reber:—Many years ago, I made some observations on the field of monocular fixation in its relation to heterophoria and muscular asthenopia.

While I regard this method as roughly useful and in most instances a practical one, yet I have never regarded perimetric measurements as efficient as the tropometer of Stevens, if for no other reason than that the ocular movements inwards can be better measured with the latter instrument. Whatever method be chosen, however, standards normal to each instrument should be established for purposes of comparison. The normal extent of each excursion is likely to vary in different forms of the tropometer, just as it varies from time to time in the same individual and in different individuals.

With this proviso let me say, that I propose what I regard as an improvement on the original lettered strips that present a mixture of letters and figures. Following a suggestion of my assistant, Dr. A. S. Rochester, a certain area on the strips is concealed by the object carrier of the perimeter so that the

patient may read continuously as fast as the carrier is removed from this fixation point. I hope to publish a description of this little device so that judgment may be passed on it.

Let me add that whenever the field of monocular fixation is measured, the recording chart should have a normal field traced on it for purposes of comparison as in the ordinary charts of the field of vision.

Cordially yours,

CASEY WOOD.

An objective perimeter method to which I myself resorted for some years with much satisfaction is to have the patient hold in his hand Schweigger's hand perimeter. A small electric light is then carried along the arc of the perimeter and the patient instructed to follow it with the eye under examination. The surgeon meanwhile determines the movement of the eye by watching closely the movement of the corneal image made by the electric light. The moment the tiny image begins to waver, the eye is reaching its limit of rotation in that particular meridian.

This method is fairly accurate, requires no special apparatus and is quickly applied. The chief objection is that it is only an approximate measurement. Howe sought to obviate the objections to this method by mounting on the arc of the perimeter a small telescope whose axis is at all times perpendicular to the arc and exactly in the direction of a radius of the perimeter. Naturally this lends the needed element of exactitude to the estimation of the ocular rotations—but the tropometer is much easier to use, in less time, and with quite as much exactness. Indeed it is so easy of application that it may well be asked why it has not come into more general use.

To appreciate properly the usefulness of the instrument, it is essential that one should be familiar with the behavior of normal eyes under its observation.

The limits of the normal field of fixation,[1] as found by early observers are shown in Table 1.

TABLE 1.—LIMITS OF THE NORMAL FIELD OF FIXATION

	Schuerman	Volkmann	Hering	Kuster	Schneller	Landolt	Duane
Up	34	35	20	33	....	44	43
Down	57	50	62	44	....	50	63
Temporalward	42	38	43	43	46-54	46	53
Nasalward	45	42	44	45	52-56	44	51

The wide variation in the excursions above cited cannot fail to excite interest. For instance, the difference in Hering's and Landolt's observations of 24 degrees in the upward rotation and 12 degrees in the downward rotation demands some manner of explanation. I think it may be found in the fact that these early observers resorted entirely to perimeter methods in their observations which, as I have already stated, are but approximate at best. Moreover, tests made with the perimeter are much more open to differences in interpretation than are tropometer tests—hence the equation of error will be much larger, as above graphically shown.

Duane (quoted by Howe) alludes to the difficulties of ascertaining the exact limits of the field of fixation; he gives the results of several measurements made on the same individual and states his belief that it seldom happens that any two tests agree exactly in all their details. That such tests do not agree *exactly* cannot be gainsaid. But that they do correspond fairly well can be claimed, I believe. Two individuals were selected for the purpose, one (A) a woman in secretarial work; the other (B) a youth of 16. Estimates were made on three different days without any knowledge of the results secured at the previous examination. The records are given in Table 2.

TABLE 2.—LIMITS OF FIELD OF FIXATION IN TWO PERSONS ON THREE DAYS

A: WOMAN IN SECRETARIAL WORK

	Up	Down	Nasal	Temporal
R. E.	32	50	50	37
	36	55	45	45
	32	52	50	40
L. E.	32	48	42	42
	35	50	45	45
	37	45	45	45

B: YOUTH, AGED 16

	Up	Down	Nasal	Temporal
R. E.	40	50	48	48
	40	50	50	50
	40	55	55	55
L. E.	42	55	55	50
	45	52	60	49
	40	55	48	48

The figures show a slight variation of from 3 to 5 degrees in the patients from day to day and in the upward rotation in one, a variant of 7 degrees as also in the temporal rotation in the other case. Naturally, if two or more observations are taken in any one case (and this is most excellent practice) they can justly be averaged and good working conclusions deduced therefrom. Indeed, repeated observations are of the same value in this line of our work as in refraction work and ought never to be omitted if the opportunity offers.

After consideration of the variations in normal rotations noted by the early observers, I was led into investigations bearing on this subject for my own satisfaction. Within the last two years I have selected fifty individuals (100 eyes) with normal muscle balance for infinity as the subjects of this inquiry. All of these individuals presented (with two exceptions) low grade hypermetropia or its allied states (1.00 diopter total or less). The two myopes showed a total of 2 diopters of error in one case and 5.50 diopters in the other.[2]

The rotations in these one hundred normal eyes were tabulated and averaged, affording the following tabulation, which I now use for my guidance:

Upward	36 degrees	Nasalward	50 degrees
Downward	52 degrees	Temporalward	48 degrees

Naturally in a series of such cases there were considerable variations from the averages just noted. For instance, in one case the upward rotation was but 25 degrees in the right eye (equals 11 degrees less than the average); however, it was but 28 degrees in the other eye, showing plainly a deficiency of upward rotation in both eyes. In this case the downward rotation equaled 54 and 52 degrees, respectively, conforming to the normal averages. This patient presented perfect muscle balance for both infinity and 13 inches (33 cm.) the occupation distance. Another case showed upward rotation in the right eye of 25 degrees and in the left eye of 29 degrees, but the downward rotations were 54 and 50 degrees, again pointing to the elevators as insufficient in their work.

On the other hand, excessive upward rotation was found in some cases, conspicuously in Case 29 of the

1. Howe: The Muscles of the Eye, i.

2. I am much indebted to Dr. Joseph L. McCool, my former office associate, now located in Portland, Ore., for the major portion of this work on normal individuals.

series in which upward rotation equaled 45 degrees in the right eye and 47 degrees in the left eye. But the downward rotations were 50 degrees in both eyes (equals normal) so that the case takes on the features of excess upward rotation pure and simple, as the lateral rotations were normal. This case presented esophoria of 1 degree for infinity, but as we generally find in cases of excessive upward rotation, there was exophoria of 7 degrees at the reading distance (13 inches). This patient (a young man of superb physical build) presented an obstinate habit blepharospasm, only partially relieved by accurate refraction and convergence training.

After repeated observations Dr. McCool and myself are both of the opinion that the factor of error in taking observations is about 5 degrees.

The variations in our own series are as follows:[3]

	Up	Down	Nasal	Temporal
Highest	48	65	60	60
Lowest	25	35	38	40

One other fact is of interest. If the averages established by the early observers already quoted in the table (Schuerman, Volkman, Hering, Kuster, Schneller, Landolt and Duane) are themselves averaged they approach very closely to those established in my own series, to-wit:

	Up	Down	Nasal	Temporal
Averages of early observers	34	54	47.4	45.7
Reber	36	52	50	48

I am therefore inclined to believe that the averages established for my own satisfaction will be likely to be pretty closely approximated by those that may be arrived at by most other present-day investigators whether in our own country or abroad.

It might be of interest also to note that I have had the eye-piece containing the tangent scale so modified that the scale can be rotated through 135 degrees of the circle instead of 90 degrees. This can be very easily done by any mechanical optician and enables the ophthalmologist to estimate the two main oblique rotations as well as the vertical and lateral ones.

While, as I have said, the tropometer is easy of application, it is not so easy to form correct judgments as to the significance of the rotations when their limits have been learned. Lucien Howe has very well said:

> It is important to remember that the limits of the fields of fixation are not to be judged *entirely by the number of degrees* which an eye can turn in any given direction. Much also depends on the *manner* in which the motion is made. In some individuals, when the group of muscles under examination is strong, the eye will turn without hesitation to a certain point . . . which is the limit of motion in that direction, and the globe can be held in that position steadily and without effort for several seconds. On the other hand, when this group of muscles is weak and the eye approaches the limit of fixation, it does so in a halting fashion.

Hence it follows that once facility has been gained in the use of the instrument, much depends on interpretation, just as in the use of the ophthalmoscope, the ophthalmometer, the perimeter, the tonometer, the microscope or any other instrument of precision in use in our science.

THE TROPOMETER IN THE STUDY OF STRABISMUS

In my hands the tropometer has not been of much service in studying the rotations of the globes in children under 7 years of age. It will be readily seen, therefore, that its use has been confined to those strabismics who have arrived at or very near the age when the operative phase of this question is uppermost. This seems to be the tropometer's largest field of usefulness. Valk[4] is devoted to it in such cases, and Edward Lauder,[5] likewise, feels that it is practically indispensible in forming final judgments as to operation.

In the sixteen case histories about to be cited, six (Group I) represent the type that in spite of the most careful orthoptic treatment, have passed their eighth year with a goodly residual deviation. No patient of this group has submitted to operation.

Six more (Group II) present the same previous history as those in Group I, save that the patients have all come to operation.

Four more (Group III) were all strabismics in their early childhood, but under orthoptic treatment alone have secured parallel axes; their rotations furnish interesting reading.

GROUP I. ESOTROPICS WHO SHOULD BE OPERATED ON

CASE 1.—W. S., 9-year-old boy, first seen when 3 years old, and esotropia equaled 35 degrees. Developed after pertussis. No family history of strabismus. Refraction in 1906 was

R.— .50 sph.—.50 cyl. axis 45 degrees
L.—1.00 sph.—.50 cyl. axis 135 degrees

Present refractive status:

R.—1.25 sph.—.75 cyl. axis 45 degrees
L.—1.50 sph.—.75 cyl. axis 135 degrees

His present deviation is 30 degrees, with vision 5/6 in each eye (pure alternating strabismus).

His tropometric rotations equal:

	Up	Down	Nasal	Temporal
R.	40	40	60	40
L.	40	45	60	40

As would be expected in alternating esotropia, both eyes show excessive nasal rotation and defective temporal rotation. The vertical muscles are not above suspicion in this case, as upward rotation is excessive in each eye and downward rotation defective (see average normals). The patient will be operated on within the next month or two by advancement of each external rectus.

CASE 2.—T. G., a 12-year-old boy, first seen at 4 years of age. Esotropia 20 degrees. Strong family history of strabismus. Refraction at that time:

R.+4.00 sph.+1.00 cyl. axis 90 degrees equals 5/7
L.+4.00 sph.+1.25 cyl. axis 90 degrees equals 5/7

Last seen January, 1912. Refraction equaled:

R.+3.50 sph.+0.75 cyl. axis 90 degrees equals 5/6
L.+3.25 sph.+1.00 cyl. axis 90 degrees equals 5/6

Deviation still equals 20 degrees.

Tropometer rotations are as follows:

	Up	Down	Nasal	Temporal
R.	30	45	60	40
L.	30	50	65	38

Thus, as in the preceding alternating case, both nasal rotations are excessive and both temporal rotations defective. Operation declined.

CASE 3.—I. S., 8-year-old boy, first seen when 5 years old. A frail puny child with a doubtful history of acute polyencephalitis a year before. Esotropia 45 degrees. Left eye deviating constantly. Refraction equaled:

R.+1.00 sph.+ .50 cyl. axis 75 degrees
L.—1.00 sph.—2.00 cyl. axis 135 degrees

Present refraction:

R.+ .50 sph.+ .50 cyl. axis 75 degrees equals 5/6
L.—1.50 sph.—2.50 cyl. axis 145 degrees equals 5/60

3. These figures will be seen to approach very closely to those set down by the inventor of the instrument (Stevens: A Treatise on the Motor Apparatus of the Eyes, F. A. Davis Company, 1906), who gives the following as his idea of normal rotations:

Up	Down	Nasal	Temporal
33-37	45-50	about 50	about 45

4. Valk: Strabismus or Squint.
5. Lauder, E.: Tr. Am. Acad. Ophth. and Oto-Laryngol., 1906.

The tropometer showed:

	Up	Down	Nasal	Temporal
R.	30	45	45	40
L.	30	53	60	33

In this, the monocular type, the abnormal rotations are confined to the deviating (left) eye, the nasal rotations being excessive and the temporal markedly defective. Operation advised—advancement left externus and tenotomy left externus.

CASE 4.—L. B., a 10-year-old boy, undersized, neurotic, son of a neurasthenic mother. First seen when 8 years old. Deviation 32 degrees, left eye deviating constantly. Present refraction:

R.+0.25 sph.+0.75 cyl. axis 90 degrees equals 5/5
L.+0.25 sph.+0.75 cyl. axis 90 degrees equals 5/15

Has worn glasses for five years. Deviation now 30 degrees. Tropometer equals:

	Up	Down	Nasal	Temporal
R.	42	45	60	45
L.	40	58	65	35

This is another typical monocular case, although the vertical muscles are not above suspicion. Operation declined.

CASE 5.—L. G., a 9-year-old boy when first seen; deviation equaled 35 degrees, always the right eye. A paternal uncle had strabismus in childhood. Patient ophthalmoscopically normal in both eyes, but examination revealed a small positive central scotoma in the right (deviating) eye. Present deviation 25 degrees. Present refraction:

R. (retinoscope)+0.75 sph.+.25 cyl. axis 90 equals 1/60
L.+1.25 sph. equals 5/5

Tropometer shows:

	Up	Down	Nasal	Temporal
R.	48	50	65	45
L.	50	45	48	45

Excessive nasal rotation in the deviating eye is here shown, as would be expected. The temporal deviation is normal, however, and the action of the elevators so markedly excessive that were I permitted to operate on this case I should tenotomize both superior recti (moderately) before directing any surgery to the lateral muscles.

CASE 6.—M. B., a 7-year-old girl, developed esotropia in her second year. Right eye deviated always. No family history of strabismus. Deviation 37 degrees, right eye. Eye-grounds normal. Refraction is:

R. (retinoscope)—1.00 cyl. axis 180 degrees equals 2/60.
L.+0.75 cyl. 90 degrees equals 5/7

The rotations are:

	Up	Down	Nasal	Temporal
R.	34	51	60	35
L.	40	45	55	40

Advised tenotomy right internus and advancement right externus. Operation declined.

In these six cases, deficient temporal rotation is shown in one or both eyes according as they are monocular or alternating esotropias; or the nasal rotation of the deviating eye or eyes is excessive; or in some cases both conditions obtain.

They may be summarized as follows:

TABLE 3.—DEFICIENT TEMPORAL ROTATION IN SIX CASES SUITABLE FOR OPERATION

Case	Variety of Esotropia		Up	Down	Nasal	Temporal
1	Alternating	R.	40	40	60	40
		L.	40	45	60	40
2	Alternating	R.	30	45	60	40
		L.	30	50	65	38
3	Monocular, L. E.	R.	30	45	45	40
		L.	30	53	60	33
4	Monocular, L. E.	R.	42	45	60	45
		L.	40	58	65	35
5	Monocular, R. E.	R.	48	50	65	45
		L.	50	45	48	45
6	Monocular, R. E.	R.	34	51	60	35
		L.	40	45	55	40

GROUP II. ESOTROPICS AND HYPERTROPICS WHO HAVE BEEN OPERATED ON AFTER TROPOMETRIC STUDY

CASE 7.—R. B., boy 9 years old when first seen, June 2, 1908. Monocular esotropia of 40 degrees, left eye deviating. Wearing:

R.—0.75 cyl. axis 180 degrees equals 5/15
L.—0.50 sph.—1.00 cyl. axis 85 degrees equals 5/30

Under thorough cycloplegia there was found:

R.—0.50 sph.+2.00 cyl. axis 45 degrees equals 5/9
L.—2.00 sph.—4.00 cyl. axis 170 degrees equals 5/12

Eye-grounds were normal. Stereoscopic exercises were ordered and faithfully followed out. Two years later the deviation equaled 30 degrees and refraction was:

R.—2.00 cyl. axis 180 degrees equals 5/7
L.—2.00 sph.—4.00 cyl. axis 180 degrees equals 5/15

The tropometer at this date showed:

	Up	Down	Nasal	Temporal
R.	45	45	60	45
L.	45	50	70	40

Dec. 27, 1912, under local anesthesia, modified tenotomy of both superior recti and internal recti; this because of the preponderance of upward rotation as shown by the tropometer. March 2, 1911, about 5 degrees of residual convergent deviation. Rotations at this date:

	Up	Down	Nasal	Temporal
R.	30	50	50	48
L.	30	52	52	45

CASE 8.—J. S., a boy aged 16, first seen July 16, 1910, with left hyperesotropia, the upward deviation being 10 degrees, the inward 50 degrees. The eye-grounds were normal. He was wearing:

R.+4.00 sph.+1.00 cyl. axis 90 degrees
L.+4.00 sph.

Under thorough cycloplegia we found:

R.+4.00 sph.+1.50 cyl. axis 90 degrees equals 5/4
L.+4.00 sph.+1.50 cyl. axis 135 degrees equals 5/7

The rotations follow:

	Up	Down	Nasal	Temporal
R.	45	42	60	45
L.	50	35	65	30

Sept. 1, 1910, under local anesthesia the left superior rectus was tenotomized, by which the left eye was brought down almost on a level with the right eye and the lateral deviation reduced 10 degrees, leaving a residual convergence of the left eye of 40 degrees. A month later operation was performed consisting of wide resection and advancement of the left externus and moderate tenotomy of the internus. Result was 10 degrees of residual convergence under cover for infinity.

CASE 9.—L. Z., a boy aged 11, first seen Nov. 13, 1911. Pure alternating esotropia of 50 degrees. Wearing:

R.—19.00 sph. equals 5/30
L.—18.00 sph.—1.00 cyl. axis 165 degrees equals 5/30

Eye-grounds characteristic of high myopia, but no staphyloma posterior, and retina and chorioid in unusually good condition. Tropometer showed:

	Up	Down	Nasal	Temporal
R.	25	40	70	30
L.	30	45	60	30

One week later, under local anesthesia, moderate tenotomy of both interni and advancement of both externi. March 1, 1911, result, residual convergence for infinity of scant 10 degrees under cover.

Refraction to-day:

R.—20.00 sph.—1.00 cyl. axis 75 degrees equals 5/15
L.—16.00 sph.—1.00 cyl. axis 135 degrees equals 5/15

These were ordered for constant wear.

CASE 10.—May 11, 1908, H. C., a woman aged 25. Esotropia since infancy. Left eye always deviating. Vision equals right,

5/7; left, 5/12. Esotropia equals 20 degrees. Eye-grounds normal. Refraction showed:

R. +0.50 sph. 25 cyl. axis 100 degrees equals 5/5
L. +0.75 cyl. axis 90 degrees equals 5/7

Rotations with tropometer:

	Up	Down	Nasal	Temporal
R.	35	50	53	40
L.	30	50	55	15

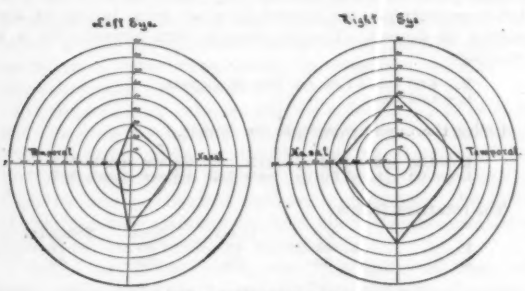
The left eye stopped promptly when the 15-degree mark was reached. Under local anesthesia, advancement left externus.

Result, residual convergence for infinity of 5 degrees. It is not unlikely that in this case there was congenital paresis of the left external rectus.

CASE 11.—Mrs. A. C., aged 30. Strabismus since childhood, always left eye. Vision, R., 5/9; L., 5/60. Eye-grounds normal. Tropometer equals:

	Up	Down	Nasal	Temporal
R.	50	60	45	50
L.	30	50	35	10

As in the preceding case, the diagnosis here was congenital paresis of the external rectus. (See illustration of motor fields.) Under local anesthesia, advancement of the left external rectus was attempted, but practically no muscle was found save a small thin fibrous tendon. Wide resection of the conjunctiva and capsule was therefore done. Result, poor. Not more than 10 degrees of external rotation gained, although the position of the eye was somewhat improved. This may be attributed to the fact that one of the stitches pulled out. The



Motor fields in Case 11.

final postoperative diagnosis was congenital underdevelopment of the left external rectus muscle.

CASE 12.—*Patient.*—J. C., a boy aged 16. Left esotropia of 10 degrees and hypotropia of 20 degrees. Wearing a good correction for the past two years (high H + Ah). The esotropia developed soon after diphtheria six years ago. Patient complained of diplopia in the upper field, giving rise to difficulty in reading and writing. Study of the double images showed paresis of the left superior rectus. The tropometer showed the following rotations:

	Up	Down	Nasal	Temporal
R.	35	50	52	40
L.	20	60	58	38

The eye-grounds were normal. Corrected vision equaled right, 5/5; left, 5/7. Under local anesthesia, wide resection (about 5 mm.) of the left superior rectus was done along with tenotomy of the inferior rectus in the same eye, and buttonholing of the internal rectus. Result one week later. Lateral balance and 2 degrees of residual left hypophoria. No subsequent estimate of the tropometric rotations was made, as the patient went to his home in a distant city one week after operation; but later he reported that he could use his eyes in all near work with perfect comfort.

Remarks.—In each of the cases in this group, the tropometer gave positive and accurate indications as to operation and as to which muscle should be operated on. It is freely admitted that by close inspection of the behavior of the ocular muscles alone most operators would have arrived at probably the same conclusion as to operation; but they would have been obliged to proceed to operation without *precise* knowledge as to the rotational powers of the muscles they were about to operate on.

GROUP III. ESOTROPICS THAT ARRIVED AT PARALLELISM OF THE VISUAL AXES ON ORTHOPTIC TREATMENT ALONE.

This group comprises four cases of esotropia that arrived at parallelism of the visual axes on orthoptic treatment alone. The first two are monocular cases—the last two alternating ones.

CASE 13.—A 14-year-old boy, studied for several years. When first seen he exhibited deviation of the right eye of 28 degrees and vision in that eye of 1/60. To-day his vision in the right eye is 5/30 and his eyes are straight. His refraction is a high H + Ah condition. His rotations are:

	Up	Down	Nasal	Tempofal
R.	35	43	45	45
L.	35	50	50	42

CASE 14.—A 12-year-old girl, whose case has been studied for seven years. Esotropia (right eye) 32 degrees when first seen and vision in that eye 3/60. After seven years' use of a good correction and stereoscopic treatment, she presents absolutely straight eyes. She is the subject of high myopic astigmatism, her vision being to-day: right, 5/15; left, 5/6 partly. The rotations at present are:

	Up	Down	Nasal	Temporal
R.	35	46	50	40
L.	30	45	45	40

CASES 15 and 16.—Brother and sister, both studied for seven years. The boy was 8 and the girl 11 when first seen. Both were treated for high esotropia by a confrère when 3 years of age. High H + Ah conditions were in evidence in both cases, totalling 4 diopters in the boy and 6½ diopters in the girl. In both cases vision is full 5/5 in both eyes, and the muscle balance is normal, with full binocular vision. The boy's rotations are:

	Up	Down	Nasal	Temporal
R.	40	55	55	45
L.	41	50	58	47

And the girl's:

	Up	Down	Nasal	Temporal
R.	32	58	50	40
L.	31	55	45	41

These cases just cited are splendid illustrations of the results that often attend the earliest careful attention to strabismic children. When the refraction is thoroughly studied and the eyes put under proper working conditions the eyes and their muscles and innervations develop along normal instead of abnormal lines. Once abnormal innervational habits have been formed, abnormal conditions probably develop in the muscles concerned, such as spasm and overdevelopment in the internal recti of esotropics and stretching and underdevelopment of the external recti. Under such conditions it will be difficult to accomplish the same result in the grown child without operation, as has just been shown in the four cases cited.

When operation becomes imperative and has been decided on, the methods in vogue are to have the patient follow the surgeon's finger in the lateral and vertical meridians. This furnishes information as to the behavior of the *associated* muscles of the eyes as well as giving some idea of the rotational power of each eye. The study of each eye in relation to its fellow ought never to be omitted, for in this way pareses are often detected. But individual study of the rotational power of each eye with

the tropometer is equally, if not more important, and will lend much greater accuracy to all such observations.

The plea is made for the fullest study of each case of esotropia before proceeding to operation; and as an aid to the exactness of details in such study nothing at present exceeds in value the tropometer.

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ABSTRACT OF DISCUSSION

DR. EDWARD LAUDER, Cleveland: The observer should be familiar with the behavior of normal eyes under the tropometer. In orthophoria there are variations from the normal rotations, namely, 33° upward, 50° downward, 55° inward and 50° outward, as given in several text-books. In all orthophoric cases, however, the approximate relative rotations, as given, obtain, so that, having thoroughly learned and appreciated this fact, we more readily learn to interpret our readings in all abnormal cases.

To any one who has used the tropometer the question of the proper adjustment of the head, no doubt, has presented itself. Great care should be used in this, and when making the ocular rotations the patient should grip the piece of wood firmly with his teeth so that he will avoid the incentive to turn his head. Perfect adjustment of the head being difficult, it is well, in investigating any case of ocular rotation, to make several examinations at different times, and in this way either prove the findings or arrive at a satisfactory average.

Considering the value of the tropometer in the study of strabismus, I cannot fully agree with Dr. Reber when he says, "This seems to be the tropometer's largest field of usefulness." What substitute have we in the investigation of numerous cases of latent strabismus or heterophoria? Furthermore, there are those two other types of cases—dextrophoria and levophoria—in the investigation of which we would be entirely at sea did we not have the use of a tropometer.

DR. FRANCIS VALK, New York: I have always held the tropometer to be one of our best instruments. It invariably confirms all the other examinations. Dr. Reber seems much worried because it does not give exact averages. We say that 20/20 is an average for vision, and yet it is not, for many must have noticed vision 20/15 and 20/10 even. If we take Dr. Stevens' records of 33 up and about 55 down and 55 in and 50 out, that is enough. What I look at is simply the relation which these figures bear to each other. What difference does it make if one figure appears to be 49 instead of 50? The point is, where these conditions of heterophoria exist, to find the relation of one to the other; then you know what the true muscle balance is. If we are specialists we must be able and willing to diagnose every case of abnormal motility. The great advantage of the use of this instrument in your practice when you come to correct the motility and refraction is beyond argument.

DR. A. DUANE, New York: While I agree with Dr. Reber as to the importance of testing the rotation of each eye separately, I cannot agree with him that this measurement is nearly as valuable a means of diagnosis or as valuable an indication for treatment as the measurement of the coordinate movements—convergent, divergent and parallel—of the two eyes acting together. All my observation has led me to believe that ordinary squint is essentially a disturbance of coordination; that it is an affection of convergence or divergence, and does not involve, primarily at least, the inward and outward rotations *per se*. At all events, some cases of squint are alike in rotations and yet are different in nature and require different treatment. Thus a convergent squint in which the convergent element is in excess, as shown by the fact that the deviation is considerably more marked for near than for distance, and that attempts at convergence beget a spasmodic inversion of the eye, is essentially different from a case in which the deviation is at least as great for distance as for near, and the converging power is evidently not excessive. And yet in these two differing cases the monocular rotations may show little or no difference. So also two cases of divergent squint may be quite alike, so far as the power of monocular rotation is concerned, and yet may differ *in toto* in nature. In one, the deviation for distance is great for distance and less for near, and the power of convergence, absolute or relative, is still good; in the other, the deviation for near is much greater than for distance, and convergence is *nil*. The former will require one method of treatment, the latter another, even though the movements of each eye in the two cases are the same. Even in paretic squint, unless pronounced, I find the measurement of the rotations of each eye taken separately an unsafe guide—far less trustworthy than the measurement of the parallel movements of the two eyes, as determined by the variation of the screen deviation in different directions of the gaze, the lagging of one eye behind the other (on the contrary its spasmodic shooting beyond the other) in one definite portion of the field of fixation, and the measurement of diplopia on the tangent plane.

DR. G. C. SAVAGE, Nashville: Dr. Reber is right in his contention that the inherent strength of a muscle to be operated on should first be known. In heterophoria this can be done in one of three ways; first, by the rotary prism, determining the duction power of the muscles; second, by the perimeter, determining the verting power of the muscles; third, by the tropometer, also showing the verting power. The duction is applicable only to heterophoric conditions, and in my judgment is the test that should be resorted to in these cases. In heterophoria the verting test alone is possible, and this must be accomplished by the use of either the perimeter or the tropometer. With the perimeter adversion is interfered with by the nose, and supervision is interfered with by the brow. With the tropometer there is no interference with the version test in any direction. Of course, both the tropometer and the perimeter could be used in determining the verting power of the muscles in cases of orthophoria, as can also the duction test by means of the rotary prism, but the latter I conceive to be far preferable. The duction test shows whether the orthophoria is sthenic or asthenic, and if the latter, it gives indication as to necessary treatment by means of exercise. In lateral and vertical heterophoria the duction power of one of a pair of opposing muscles should be greater than the duction power of the other member of the pair, and yet the one with greater power may, in itself, not be intrinsically too powerful, and if this be the case, the strong muscle should not be operated on, but the weaker muscle should be given greater strength by being advanced or shortened, the latter being the safer and the surer operation. Even the duction test will show that the stronger muscle is inherently too strong, and yet the excess in strength is not very great, and then the indication would be to do a partial tenotomy of the stronger and a shortening of the weaker muscle. If in a case of esophoria the abduction should be 6 or 8 degrees, then the internus alone should be operated on. In determining the muscle to be operated on and the character of operation to be done, the tropometer or verting test would not fall far behind the phorometer or duction test. Only the verting test is available in cases of heterotropia. If the too strong muscle has excess of verting power, it, of course, should be weakened, and in nearly all cases this will be true; or if its excess of verting power is not great, then the balance must be restored by shortening or advancing its opposing muscle at the time that the tenotomy of the too strong muscle is done. The tropometer will rarely fail to show that the too strong muscle has too much verting power; hence, in nearly all cases of heterotropia such a muscle should be weakened. The cases are rare in which a weak muscle should not be simultaneously shortened or advanced.

DR. WENDELL REBER, Philadelphia: The point as to heterophoria touched on by Dr. Valk is one of the things that led me to take up the tropometer once more. I was careful to say that in high-grade latent deviations the instrument would be advantageous, but in ordinary cases of imbalance I am still skeptical. I agree absolutely with Dr. Duane about the study of coordination or associated movements. I believe that by combining the study of the associated and coordinated movements with a study of the individual muscles, we shall arrive at information about the eyes that we have not heretofore had.

SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

PAPERS† AND DISCUSSIONS

THE SPECIALIST IN MEDICINE*

GEORGE E. SHAMBAUGH, M.D.
CHICAGO

The practicing specialist in medicine has made for himself a secure position. The advantages afforded by concentration of effort in a restricted field and by closer attention to details have given to the specialist a peculiar opportunity of taking an important part in medical progress. The development of the fundamental sciences underlying medicine owes a great deal to the efforts of the practicing specialist whose studies have reached out to problems in physiology, in anatomy, in embryology and in all the sciences which touch his field of work.

The specialties stand out distinctly as outposts along the advanced line of medical progress. The real specialist in medicine, as in any field of work, is one who by persistent and concentrated efforts succeeds in placing himself in touch with this advanced line and in a position where he is able to see and to attack the various unsolved problems in his particular field. The idea of investigation, therefore, is fundamental in the conception of the real specialist whether he be a specialist in medicine or in another subject. The problems in clinical medicine which more often attract the practicing physician differ only in kind from the problems which the distinctly laboratory worker sets out to solve. The practicing specialist in medicine should be familiar with the methods of research and be able to apply them in the study of cases and in the solution of his clinical problems.

Could anything be more inspiring to the young man entering the practice of medicine than the opportunity offered by the specialties, in which, in limiting his work to a particular field, he may hope by concentration and perseverance to get in touch with the advanced line of medical progress and to take an actual part in the solving of its problems? That man who has the perseverance to succeed in this effort has earned the right to be called a specialist in his chosen field. The dilletant in medicine who loiters along the wayside and never makes himself master of his subject is not a real specialist any more than this type ever becomes a recognized specialist in any field of work. We are inclined to use the term specialist too loosely in medicine. Any practitioner who essays to restrict his practice to a particular field thinks he has the right to be called a specialist. He may be a mere dilletant in medicine, and, as far as his knowledge of the specialty goes, an ignoramus pure and simple, yet he may pose before the public as a specialist, an expert, an authority, in a technical and difficult field of work.

This opportunity for concentration of effort and for doing scientific work has attracted to the medical specialties in this country and abroad many from the best type of medical practitioners. These are men who are persevering, aggressive, who have the instinct for investigation and whose efforts have secured for the specialists in medicine their recognized position as consultants, as experts in solving difficult clinical problems. The specialties in medicine are unfortunate, on the other hand, in attracting also a less desirable class of practitioners, men whose chief interest in their work is commercial and who think they see in special practice opportunity for receiving larger returns for their services. In this respect the specialties resemble surgery, which, as compared with internal medicine, attracts a disproportionate share of those less desirable men whose interest in medicine is largely commercial and who lack the full measure of those higher humanitarian instincts which attract many to the study of medicine and which should be a conspicuous element in the character of every one who holds the position of medical adviser in a community. We have to admit that it has been chiefly the surgeon and the specialist and not the consulting internist who have been guilty of the dishonest practice of overcharging and of the division of fees.

We are facing at present in this country a situation which reflects discredit on the general medical profession and particularly on the specialties of the eye, ear, nose and throat. The situation is one that has developed out of our deplorable lack of proper standards in medical education. It has been shown[1] that but a couple of years ago we still had in this country more medical schools than are to be found on the whole continent of Europe. A large number of these are purely commercial, proprietary institutions, with practically no standards and sustained chiefly by clever advertising methods. The result has been an enormous overproduction of "uneducated, ill-trained medical practitioners." We have in the United States, for example, four or five times as many physicians in proportion to the population as exist in an older country like Germany.

The specialties of the eye, ear, nose and throat have had to carry a disproportionate share of these uneducated, ill-trained practitioners, who, failing to succeed in competition with the better trained men in their communities, seek to better their condition by limiting their practice to these special fields. The loose way in which in this country we have countenanced the use of the term specialist has made it possible for these men, with often no further preparation than a few weeks' attendance at a postgraduate school, to pose in their communities as qualified specialists in the eye, ear, nose and throat. In many towns, throughout the middle west at least, where the legitimate work in these special fields could be easily taken care of by one, or at most two properly qualified specialists, it is not uncommon to find six or more practitioners advertising on their signs and in the local papers as specialists in the eye, ear, nose and throat. In these cities a larger number of practitioners are sometimes found limiting their work to these specialties than are engaged in the whole field of general practice. It is needless to point out that the public suffers through this overproduction of untrained specialists. It is this type of specialist who justifies the fear so often expressed that the specialist, working in a restricted field, may lose the proper sense of relation

* Chairman's address.
† As the footnotes indicate, certain papers are here printed in abbreviated form.

1. Medical Education in the United States and Canada. Report to the Carnegie Foundation for the Advancement of Teachers, 1910.

between his work and that of the internist. The lack of a proper general medical education and a faulty preparation for special practice give to these men their narrow perspective which makes them disposed to see all human ailments through the particular speculum they may be using.

The postgraduate schools of this country are supported largely by the attendance of practitioners who are seeking courses on the eye, ear, nose and throat. In foreign medical centers, where courses are offered to practitioners of medicine, most of the men taking these courses are Americans, and of these at least 90 per cent. are looking for courses in these specialties. Our postgraduate schools are often blamed for encouraging the development of the so-called "six-weeks specialist," the type which the late Professor Schwartze designated as the "pseudospecialist." As a matter of fact, however, the postgraduate schools are doing only that which is demanded of them. When the majority of the men who come to these institutions are uneducated, ill-trained practitioners, who expect after a few weeks' or at most a few months' attendance on courses to return as qualified specialists, what can be done? To meet such a situation only the most superficial, elementary, so-called practical instruction can be given. No sustained effort can be attempted to give that special training in the fundamental sciences of anatomy, physiology, embryology, etc., which should form the foundation for any one who is preparing to do special practice. The courses covering the specialties which are required of the undergraduate student in our best medical schools are superior in every detail to those courses now offered in the postgraduate schools to prospective specialists.

The courses for practitioners both here and abroad naturally fail signally to give that sort of preparation which ought to constitute the fundamental training for every bona fide specialist whether in medicine or in another subject. This is the training for investigation, for research. Courses of instruction, the sole purpose of which is to drill the student in the established facts in medicine, are at best but superficial. The course which leads the student to approach these facts with the open mind of an investigator gives him the training best suited to meet the problems in routine practice. It is not so much the number of facts that a student acquires as it is the methods for investigating these facts that is of greatest value. The question has often been asked why it is that from so many of our physicians who seek postgraduate study abroad so few ever reach that advanced position where they are able to make actual contributions to medical progress. One reason is that most of them have been content in their studies to have facts ladled out to them and have failed to obtain the really important things — the spirit of research and the methods for investigating these facts.

The discredit which the overcrowding of the profession by uneducated, ill-trained practitioners has cast over the specialties in this country is but temporary. The medical as well as the lay public are demanding more and more that the physician who would be recognized as a specialist must have adequate preparation. In this country, just as abroad, he must identify himself with scientific medicine and win his spurs by making some real contribution to medical science. The readjustment throughout the country of the proper relation of the specialist to the general practitioner, the relation of the consultant, the expert, who by perseverance has pushed through to the advanced line in his chosen field, this readjustment will be hastened very much by correcting the existing evils in our system of medical education. Already this is being worked out. Already we can see the passing of the commercial proprietary medical school. Medical education in this country is to be taken over again by the university where it formerly was and where it rightfully belongs. Those spurious medical departments of universities, the attached proprietary institutions, where all that the university gave to its medical school was its name, are already disappearing. In their place will be developed the real university department of medicine, in which the idea fundamental in any department of a real university, the idea of investigation, will be made prominent. It is toward this goal that the trend of medical education is leading.

We are still far from the realization of an actual university department of medicine, although we have passed the stage where a self-respecting university willingly permits its name to be attached to a proprietary medical college. We recognize that a medical school organized as is the proprietary medical college cannot be called a bone fide department of a university. It will take time and patience to work out the development of the university department of medicine from the existing type of medical school, for there remains a long step between the medical school as it still exists in this country and a bona fide department of a real university. The full significance of this difference will not always be recognized by men who have grown up in the atmosphere of the proprietary medical college. These men are often found opposing the introduction of university ideas and university methods in medical teaching on the plea that the medical student needs practical as opposed to scientific instruction, that the research man is not the best instructor, etc. They are all anxious enough to have the institution called the medical department of a university but are opposed to the introduction of those methods and ideas which alone can make it a bona fide department of a university. Actual progress in the development of the real university department of medicine must come chiefly from the university. The American Medical Association, working through its Council on Medical Education, has in a very few years accomplished a great work, especially toward standardizing the entrance requirement for medical schools, but the keynote to the medical school of the future, the university department of medicine, must come from the university itself, where alone the ideals and aspirations of university instruction are fully appreciated. President Shurman, in an address on "The Obligation of the University to Medical Education," has sounded this note where he says: "Have done with this sham in medical education . . . let this new institution be not an attachment (or detachment) to the university but an organic and vital member like other departments of the university, and, like them, animated by its spirit and controlled by its standards."[2]

If the undergraduate instruction in medicine ought to be in the hand of the university, even more urgent is it that the real postgraduate instruction must be undertaken by the university. When the undergraduate instruction in medicine has been thoroughly done, the elementary work in the specialties will not need the "subsequent patching" which is all that the existing postgraduate schools are prepared to do. Real postgraduate instruction in medicine can develop only in connection with a university department of medicine, not in separate, so-called postgraduate institutions. When once

2. THE JOURNAL A. M. A., April 16, 1910, p. 1251.

the universities have completed the process of taking over the undergraduate instruction in medicine and have established real university medical departments, it is their problem to provide suitable courses for the training of the medical specialist. Such courses should be arranged to cover at least two or three years' work after the undergraduate instruction in medicine has been completed. They might very properly be of such a character as to lead to the higher degree in medicine, the degree of doctor of philosophy, for example, in ophthalmology or otology. These specialties are fully as technical and as far removed from general medicine and general surgery as is dentistry, yet the state requires of the dentist three years' special training. The public is entitled to at least the same protection from untrained specialists in medicine as from untrained dentists, particularly since the work in these specialties is the more difficult and also more dangerous. The development of the specialties in medicine is so recent that we have not as yet become thoroughly adjusted to the new situation. The training of the specialist presents an entirely new problem in medical education. The feeble efforts that have been made in postgraduate schools to supply this training have fallen far short of really solving the problem. When once the proper facilities are offered by the universities for adequate training in the specialties, it is but a short step for the state to require this training before the practicing physician can enter special practice.

All that we offer now for the training of the specialist is an attempt to provide the top story of his preparation, the purely clinical aspect. Is it any wonder that so many, doing special work with this sort of preparation and no adequate general medical training, become top heavy and overtreat patients locally who should be referred back to the general physician? It is no surprise that under these conditions the nearest approach to a scientific contribution, from so many who share this advantage of working in restricted fields, is the more or less garbled case report. The surprising thing is that with conditions as they are at present there should have developed in this country so large a body of real scientific specialists, men who have mastered their subjects, who are doing aggressive work in real medical progress, and who easily take their position among the foremost practicing specialists in the world. We have much for which to be proud and when once our temporary impediments have been removed, when conditions in this country are made more favorable for the development of the trained scientific medical specialist, we may confidently hope to take a much more prominent part in the progress of medical science.

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ETHMOIDITIS AS A COMMON SEQUEL (NEVER THE CAUSE) OF POLLINOSIS † (HAY FEVER)

FRANK C. TODD, M.D.
MINNEAPOLIS

It has been proved by the work of Dunbar, supplemented by the researches of Kamman, that the pollen of certain grasses, grains or weeds is responsible for the production of pollinosis in susceptible individuals. Not only has it been demonstrated by Dunbar that the pollen of these definite grains and weeds is the sole exciting causative factor, but he has succeeded in isolating from the pollen a certain albuminous portion which is the toxic agent. This poison not only gives rise to the familiar symptoms of pollinosis but is so intense a poison to susceptible individuals that as small a quantity as 1/40,000 mg. will produce a reaction, although a much larger dose is inert in the case of people not susceptible. The susceptibility of different patients varies in degree. It has been demonstrated that a small dose given hypodermatically will quickly kill an animal susceptible to hay fever.

Symptoms are general as well as local, though eye symptoms and nose symptoms predominate because here the pollen gains its easiest access. The poison, however, will affect the susceptible patient wherever applied, be it on the mucous membrane of the eyes, nose, mouth, throat or rectum, and likewise may affect the skin when rubbed on the surface, while most ready absorption takes place when it is administered hypodermatically.

The other symptoms are largely nervous in character—irritability, loss of sleep, loss of appetite, etc.—and these nervous symptoms will be present in any individual, unless his susceptibility is slight, regardless of whether or not he may be classed as a neurasthenic. Such symptoms have resulted in misconception on the part of the medical profession, and the disease has been wrongly classed as a neurosis, in the sense ordinarily meant by that term. Nasal malconditions, deformities, and so-called sensitive areas are not causative factors in hay fever, and the disease is often found in patients having normal nasal conditions; but naturally patients having nasal malconditions suffer more with nasal symptoms.

This preamble ought not to be necessary as these facts are well known and have been thoroughly proved. They are here reviewed and emphasized because despite their truth a large part of the medical profession seems unaware of the facts or else fails to interpret their significance, and our books still continue to publish old theories, long since proved untrue, regarding hay fever.[1]

HOW ETHMOIDITIS AND OTHER SINUS AFFECTIONS RESULT FROM HAY FEVER

During each attack of hay fever swelling of the turbinates takes place, causing defective drainage; secretion occurs, infection is added thereto and we have present during pollinosis, ethmoiditis and sometimes pansinusitis. The recovery of the sinusitis usually occurs when the pollen ceases to circulate in the air but repeated attacks of pollinosis may result in a persistent lesion and thus the patient may develop chronic ethmoiditis, sphenoiditis, frontal sinusitis or pansinusitis, often accompanied by persistent swelling of the turbinates and especially the middle turbinate.

Thus is explained the frequent prevalence of chronic ethmoiditis (and other sinus complications) with attendant polyps, swelling of the middle turbinate, etc., so often found present in hay fever patients. It also explains the error which rhinologists have made, in assuming that because of the coincidence of hay fever in conjunction with ethmoiditis, swollen middle turbinates and polyps, hay fever is the result of such nasal malconditions.

† Pollinosis, meaning "pollen-disease" or "pollen-sickness," was suggested by me in a paper published Aug. 15, 1908, in the *Northwestern Lancet*, as an appropriate name for the disease, of which we have two common forms, i. e., pollinosis æstiva (summer pollen-sickness), the miscalled "rose fever," and pollinosis autumnalis (autumn pollen-sickness) or "hay-fever." Other names which have hitherto been suggested, such as hyperesthetic rhinitis, do not properly apply, as they signify a disease limited to the nose only.

1. Every rhinologist should read Dr. Relk's article on hay fever in his recently published book on "Diseases of the Nose and Throat." Dr. Relk truly states the facts and severely criticizes the medical profession for its ignorance on the subject of hay fever.

Nasal deformities, lesions and "sensitive areas" have been held responsible for hay fever for many years and now that they must be discarded sinus diseases are also erroneously held responsible. So good an authority as Ballenger in his book discussing the causes of hay fever, makes the following admission: "I have seen cases (of hay fever) in which there was no obstructive septal deformity and no absolute occlusion of the olfactory fissure by turbinal enlargement." Yet later he speaks of the "boggy edematous condition" that is often present in the middle turbinate, and says: "While I do not care to promulgate a new theory as to the etiology of hay fever, I have been impressed with the possible relationship of catarrhal sinusitis, particularly ethmoidal and frontal to hay fever." By which he means that hay fever may be the result of sinusitis. The relationship does exist, but the hay fever is the cause, not the result, of the sinusitis.

A study of many such cases occurring in my practice caused me to realize the truth of these conclusions, and I am sure that a careful study of the histories of the many cases of ethmoiditis and frontal sinusitis occurring in conjunction with hay fever will convince the observing rhinologist of the truth of these assertions. The two typical cases briefly described at the end of this paper are reported merely for the purpose of illustration. Many more are among my records.

WHY ASTHMA PERSISTS AFTER THE END OF THE HAY-FEVER SEASON

As a consequence of the swelling of the middle turbinate body, with or without ethmoiditis, and its possible attendant polypoid condition, reflex asthma develops which lasts as long as these conditions persist, and thus we have the probable explanation of the existence of asthma after the hay-fever season has ended. In these cases a cure of the asthma may be effected by a removal of the nasal hypertrophy and exenteration of the ethmoid cells and in such cases the nasal symptoms are benefited, but the original disease (pollinosis) is not cured.

CASE 1.—Mrs. S., aged 29, consulted me June 16, 1911.

History.—She has had hay fever every autumn for many years. When in California she had "rose fever" in May one year. Later, she had nasal hay fever symptoms even in winter and had polyps removed eight years ago and at various times since. She now has "hay fever" symptoms the year around with constant discharge and sneezing; the nose stops up easily. She has attacks of bronchitis and bronchial asthma; also acute attacks of deafness.

Examination and Operation.—This showed numerous polyps—ethmoidal and sphenoidal. Exenteration was performed; the cells were found full of granulation-tissue and polyps. This resulted in cure of the nose, ear and bronchial symptoms; there was no recurrence of the polyps. Hay fever symptoms are not so severe and are only present during the hay-fever season.

CASE 2.—Mr. J., aged 49, consulted me April 20, 1911.

History.—For eleven years he has had hay fever every autumn. Each year the disease has been somewhat worse and the symptoms have persisted longer. He has had polyps removed nearly every year for the past few years.

Examination and Operation.—Polyps and other evidences of ethmoiditis were found. Ethmoidal and sphenoidal cells were exenterated with resultant cure of the disease. There was no recurrence of polyps nor of other symptoms except the hay-fever symptoms occurring during the season.

ABSTRACT OF DISCUSSION

DR. H. O. REIK, Baltimore: I particularly emphasize the point Dr. Todd makes, that, when ethmoiditis is seen in association with hay-fever or pollinosis, it is always as a concomitant condition or a sequel thereto, and never as the cause of hay-fever. I do not mean to say that hay-fever never occurs in a person who has a previously established ethmoiditis, but that if it ever does so happen, that occurrence does not in the least degree tend to prove a causative relationship between the two affections. As Dr. Todd has well shown, when any relationship does exist it is much more reasonable to assume, and very easy to prove, that the sinusitis is a secondary pyogenic infection during or following the long-continued inflammatory stage of the hay-fever. It must not be forgotten, either, that there are few diseases more carelessly diagnosed than is hay-fever. Every person who has attacks of frequent sneezing or rhinorrhea is called a hay-feverite. Now, those symptoms may occur at any season of the year and in association with various nasal disturbances; for instance, with chronic ethmoiditis, and have little in common with true hay-fever. If you will investigate those cases of hay-fever alleged to have been cured by ethmoidal or other operations, you will find that they were not cases of true hay-fever at all. The point of the whole thing is that the profession, and especially the rhinologists, should give this disease more honest thought and consideration and should make a careful study of each case before pronouncing the diagnosis. In the next place, we should cease this vain search for some gross lesion in the nose on which to blame the attacks and recognize the real cause so completely and thoroughly established by Blackley as long ago as 1873, and definitely proved more recently by Dunbar.

DR. G. L. RICHARDS, Fall River, Mass.: I do not feel that the general profession is so far in the background as Dr. Todd seems to think. Most of us have for many years assumed that the nasal lesion was only an aggravating factor and not the real cause of the disease. The paper is very interesting and very timely, especially as many men may perhaps have not observed the pathology of the condition so thoroughly. I do not think we can as yet rule out the neurotic element of the disease.

DR. W. L. BALLENGER, Chicago: All of us are inhaling pollen, and yet only a few develop the disease; there must be a predisposing factor. The pollen is only an exciting cause. A neurosis may be a predisposing cause, and yet it is true that most neurotic people do not have hay-fever, so that is not sufficient to stand as a predisposing cause. It is something else, and to my mind it is that condition in the nose itself which lowers the vitality of the nasal mucous membrane, and the conditions which will do this we know are obstructive lesions which interfere with drainage and ventilation, and finally lead to one type or another of ethmoiditis; not necessarily the suppurative form, but a catarrhal ethmoiditis. There is a wide range in the pathology of ethmoiditis. In hay-fever we are sure that the patient is suffering from one type or another of ethmoiditis. Dr. Shadel of St. Paul advanced the theory that it was due to antrum involvement, but, to my mind, he could more correctly have said ethmoidal, although any of the sinuses could constitute a predisposing cause. I believe these patients all have some type of ethmoidal disease, either the hyperplastic type, with or without polypi, or simple infectious ethmoiditis, and that this condition produces an irritation and lowers the vitality of the nasal mucous membrane, allowing the pollen, when it comes in contact with this sensitive membrane, to produce the phenomenon of hay-fever. It does not seem rational to me to say that hay-fever causes the ethmoiditis. I believe it is predisposing and that the hay-fever excites it to still greater activity. Therefore, I think that Dr. Todd is working backward in his investigations, and that we must look for our predisposing cause in a pre-existing sinus disease of one type or another, and I have repeatedly cured hay-fever by removing the ethmoidal mass. One lady from Iowa who for many years sat up to sleep for three months in the year had a radical ethmoidal exenteration, a double Killian, and was so relieved that she stayed at home for years during the hay-fever season. Occasionally, a small polyp would recur, and on its removal she would again be all right. I am open to conviction, but am not at all convinced as yet, and I still believe that hay-fever is one of the many forms of expression of some type of sinus disease.

DR. H. W. LOEB, St. Louis: I have never cured hay-fever by operating on the sinuses. Dr. Ballenger may say that I have not done a complete operation, but I am sure I have been radical enough in these operations. I have had one experience extending over twenty-one years with one patient. With her hay-fever she had severe asthma. After operation the asthma cleared up, but the hay-fever continued just the same; five years later the asthma returned and I again operated and the asthma again disappeared and the hay-fever continued. This went on for eleven years. Five years ago I operated again, and this time I did as complete an operation as I could; since then the patient has had no asthmatic symptoms, but still has hay-fever just the same. If Dr. Ballenger is going to explain the matter of predisposition from a clinical standpoint he has a big task. It is better to accept the explanation that has been given us by Dunbar, who has shown that he can produce the disease at will in the susceptible patient, even in winter, simply by the use of a little of the toxin in the eye. He almost killed himself by injecting a little of the toxin subcutaneously. The question probably belongs to the realm of anaphylaxis, and the real cause must be looked for along this line. I do not often find in my own practice a suppurating sinus with hay-fever. I find enlargement of the turbinates, and the patients are relieved somewhat of their obstructive symptoms by these operations, but that I am reducing the predisposing cause a single bit in operating I do not believe.

DR. C. F. WELTY, San Francisco: I think it is only now and then that a sinus affection will be a predisposing cause of hay-fever. In San Francisco I do not believe that we have the typical cases of hay-fever, or they are very few. Once in a while I get a case from the country. I can say this in behalf of the proposition, and I said it six or eight years ago on the same subject, that hay-fever is dependent on a pathologic lesion, malformations or sensitive areas in the nose as the predisposing factor. The other day a patient said to me, "When I go into the sunlight I begin to sneeze." On examination I found hypertrophy of the septum in the middle turbinate region, and hypertrophy of the anterior end of the middle turbinate as well. Now it is evident that if this lesion is allowed to continue, the patient will sooner or later have the hay-fever symptoms. In fact, all my patients with so-called hay-fever have been cured by intranasal operation.

Dr. F. V. LAURENT, Pittsburgh: I believe that Dr. Todd's idea is correct; that the hay-fever causes the ethmoiditis, for we see so many cases in which there are no malformations whatever. Then, too, we must recognize the neurotic element. Another thing that we do not recognize sufficiently is that at this period of the year these patients catch cold easily and there is an impaired vitality. Certainly, in many cases there is no lesion whatever and nothing to operate on.

DR. OTTO FREER, Chicago: While hyperplastic ethmoiditis and chronic swelling of the middle turbinate do accompany hay-fever, it has not been my experience that hay-fever is so often based on or connected with these conditions, or that they are especially characteristic of the disease, while sinus disease is certainly not a frequent complication of hay-fever. The principal pathologic change in my experience is chronic intumescence and chronic hyperplasia of the lower turbinated bodies, with absence of disease in the ethmoid region beyond hyperesthesia.

DR. P. M. HICKEY, Detroit: It seems to me that this matter under discussion is largely one of nomenclature. We are accustomed to speak of hay-fever as a disease in which the patient's symptoms are sneezing and rhinorrhea. This is giving it too wide a latitude. There is no doubt as to the etiology of the pollen of the ragweed, and it has been definitely proved that this is the etiologic factor. The individual has an anaphylaxis that renders him intolerant of this pollen. I saw 100 students taken in one experiment, and those who had a susceptibility to pollen showed the lacrimation immediately on the instillation of a watery solution of the ragweed pollen in the conjunctiva, while others who did not have this susceptibility showed no evidence of any local disturbance. Accordingly, I think we should reserve the term "hay-fever" for those cases that have this anaphylaxis and adopt a different term, for those who have a rhinitis due to a pathologic condition of the ethmoidal cells.

DR. J. F. KLINEDINST, York, Pa.: I have been a victim of hay-fever from the age of 10 to 40, suffering most severe asthmatic attacks from July to November every year, and I believe I have cured myself, without having had any ethmoiditis as a sequel. I had been treated by several good rhinologists, with the galvanocautery many times; also all nasal obstructions were removed, with only partial relief. I had tried many remedies, and finally came to the conclusion that the trouble was due to intestinal toxemia from the use of too much proteid food. By reducing my proteid food during the spring and summer seasons and using sodium phosphate twice weekly to flush the bowels, I found that the hay-fever was lessening and it eventually gradually disappeared. For the local symptoms a spray of quinin hydrochlorid and antipyrin, each 5 grains to the ounce of water, gave me great relief. With this line of treatment I have cured three patients and relieved many others. I think Dr. Ballenger is right in that there must be some predisposing cause. I am convinced that in many patients the predisposing cause is due to intestinal toxemia from too much proteid food or to chronic intestinal stasis. The absorption of the toxins, I believe, irritates the nerve centers, or, in their elimination, cause irritation of the various mucous membranes.

DR. G. F. COTT, Buffalo: My experience has been similar to Dr. Ballenger's. I do not believe you will contract hay-fever with healthy sinuses. The sinus disease is merely a concomitant condition, necessary to produce hay-fever. I maintain that there is some toxin or some antibody in the blood to cause that; when anaphylaxis is better understood, the question will be explained along that line. I expect to see Dr. Ballenger's theory substantiated in a few years.

DR. EMIL MAYER, New York: The whole trend of the discussion shows that everybody is right. In other words, there are cases entirely due to sinus disease originally; there is a condition in which it is associated with some malformation of the nose and a correction of that relieves the patient; there are others directly due to the pollen; but what about the man who gets it when he rides behind horses or in the presence of cats? Then come the patients relieved by the treatment of intestinal indigestion. You are all right; the fact is that it is a mixed subject. There is some unknown neurotic condition which renders certain people susceptible to a particular poison. We are rhinologists, of course, and want to blame the nose when we can, but it is not always a factor. Some have only a conjunctivitis; others asthma. As to Dunbar's experiments, they are very convincing as far as they go. I had the honor of receiving the first specimen of his toxin before anything was published on the subject. He selected a few men in each country, and I had a chance to make early experiments. I made one very interesting one; a hay-fever patient of mine had a drop of the toxin placed in the lower lid while he had no hay-fever, and for a control I put a drop of the same liquid in the eye of my wife who had never had an attack. Both developed conjunctivitis within five minutes and both were relieved by the antitoxin. To my mind that showed that the patient had the susceptibility to the disease, and that had my wife been subjected to the opportunity she would have developed hay-fever. But to return to the question, it is likely that ethmoiditis may follow hay-fever but there are so many who never develop ethmoiditis independently.

DR. H. F. PYFER, Norristown, Pa.: Five or six years ago I operated on a number of patients suffering from hay-fever, in whom were found deviation of the septum and sinus conditions. In all these patients there have been decided improvements but no permanent cures. Frequently there was present a hyperplastic degeneration of the mucous membrane lining the ethmoidal cells which on inspection showed no apparent disease. Now hay-fever patients are told that operative procedures will relieve but not cure. The causes of hay-fever can be summed up as: first, an unusually sensitive mucous membrane; second, a highly neurotic condition of the individual; and third, an irritant pollen.

DR. W. E. SAUER, St. Louis: The whole question seems to be one of susceptibility. Dunbar produced the reaction only in susceptible individuals. To say that the hay-fever patient has no pathologic nasal lesion is one thing; but to prove it is another. There are undoubtedly some pathologic lesions in the nose which are not revealed by our present methods of examination.

DR. F. C. TODD, Minneapolis: I have no particular objection to the use of the word neurosis, provided it is used to mean something different from what is usually meant by it, but the fact that we do not know what this predisposing cause of hay-fever is should not permit the conclusion that it is a neurosis; that is simply falling back on an indefinite term. I suggested the name "pollinosis" (that is, I speak of the disease caused by pollen) to distinguish it from other forms with similar symptoms not due to pollen. The disease caused by pollen is the true hay-fever and not the condition occurring irrespective of that factor. It is this second kind that Dr. Ballenger cures. I am convinced that what I have taken the liberty of calling "pollinosis" is not dependent on any nasal malformation. That fact, it seems to me, is proved because we can, in a susceptible patient, produce the symptoms at any time of the year with the toxin, and it is not necessary to put it into the nose at all; application to the eye will produce the eye symptoms and not necessarily the nasal symptoms; likewise they can be produced by application to any mucous membrane, whether it be the mouth, nose or rectum. I should like to have the profession acknowledge that the cause is not necessarily a neurosis but pollen and some absolutely unknown predisposing cause. It is interesting in this connection to note that statistics show, as you all know, that asthmatic patients rarely develop tuberculosis of the lungs; likewise hay-fever patients rarely develop tuberculosis. It has also been observed that the eosinophils are increased in hay-fever and asthma and not in tuberculosis. This may have a bearing as a causative factor and it is more scientific to so consider than to satisfy ourselves with calling the disease a neurosis. We have the further clinical evidence that all of us for years have done multitudes of nasal operations on hay-fever patients with failure to cure. Hay-fever patients will have symptoms at any time of year if they go into a barn where there is hay. I am not prepared, however, to say that there is not a disease giving rise to similar symptoms caused by the emanations from a horse; the point I am making is that these pollen diseases are not caused by a local nasal lesion.

THE ROENTGEN RAY IN OTOLARYNGOLOGY

PRESTON M. HICKEY, M.D.
DETROIT

In introducing the subject of the value of roentgenology in otolaryngology, it is fitting to call attention to the great aid which American investigators have rendered in this field. While the painstaking work of our brethren across the water, particularly in Germany, has done much to develop the special technic necessary for the best results, I take pleasure in mentioning the work done by many American roentgenologists. Our knowledge of the anatomy and pathology of the frontal sinuses has derived much benefit from Roentgen investigation. We are able to measure accurately the exact width and extent of these bony caverns, the thickness of the anterior wall, and the distance of the anterior wall from the posterior. We can also determine the number and extent of the septa.

These anatomic facts are invaluable data in deciding many of the questions which may arise in operative cases.

The condition of the anterior wall of the sinus can be demonstrated in lateral plates as shown in three cases in which I was able to diagnose positively the presence of syphilitic necrosis of the anterior wall. The worm-eaten erosion was absolutely pathognomonic. In one case, the sinus required to be opened in order to afford relief from the pain, but in the other two cases antisyphilitic medication was all that was necessary to afford relief.

In the differential diagnosis of the presence or absence of secretion within the sinus, it is preferable that the examination be made with the patient in the upright position. If the sinus is only partly filled with fluid and the examination is made with the patient lying on his face, the fluid may be distributed in a thin but uniform layer and cause uncertainty in the interpretation of the plate. If, however, the patient is in the upright position, the plate will tell us if the sinus is entirely or only partially filled with secretion. In the examination of doubtful cases, the plates can be made at a time of day when from the patient's symptoms we would expect the sinus to be filled or when from the presence of the pain, we would expect that the retained secretion has not drained away.

In the last few months the intensifying screen has been used by many Roentgen operators in the investigation of the frontal sinus. While this device has the great advantage of shortening the time of exposure, converting what was formerly one of the difficult tasks of the roentgenologist into one much easier, the utmost care should be exercised in the interpretation of the plates obtained with the intensifying screen. Overexposure and the use of a tube of too great penetration will result in obtaining plates of little contrast and in which may be easily lost the slight difference of density on which the diagnosis depends. In careful hands, however, and when experience has been the teacher, the use of the intensifying screen marks a great step for the average operator.

The stereoscopic investigation of the frontal sinus has resulted in the production of plates which are of great anatomic interest but which, aside from their demonstration of structure, have not yet proved that from the standpoint of diagnosis they possess any considerable advantage. The stereoscopic plates of the probe in the frontal sinus are usually striking and determine at once whether or not the canal has been properly catheterized.

Aside from being a corroborative aid to transillumination, the value of the Roentgen method in the study of antral diseases lies in the opportunity which it offers of differentiating between cases in which the infection has been of nasal and those in which it has been of dental origin. Carefully made films of the roots of the teeth adjacent to the infected antrum will at once tell whether the operative route should be intranasal, or whether the area about the diseased root should be attacked. It certainly avails little to drain an antrum through the nose if there is a constant source of infection in a diseased root of an adjacent tooth.

The presence or absence of ethmoidal disease can often receive much aid in its diagnosis from the *x*-ray plate. If the pathologic condition has converted the ethmoidal cells from a pneumatic condition to one in which the air has been replaced by retained secretion or granulation tissue, the plates will afford a graphic diagnosis, particularly if the lesion is unilateral, so that the diseased side can be compared with the normal.

In the investigation of the sphenoidal sinuses, we are confronted with technical difficulties due to the fact that the shadows of the sphenoidal sinus are so superimposed on other bony parts that there results difficulty in the interpretation. The shape of the sphenoidal sinus and its depths can be shown with comparative ease. If we

wish to differentiate one sphenoidal sinus from another, we can make oblique exposures so as to avoid superimposing the shadows of the two sinuses one on the other. The differential diagnosis between a sinus which is filled with secretion and one which is not, however, still presents great difficulties.

It has been suggested that after cocainization of the pharynx, a film as large as can be borne by the patient be placed in the mouth and the ray passed from above and behind so that the shadow of the sinuses will fall on the film. The principal ray should pass about 1½ inches anterior to the external auditory canal and should form an angle of 10 degrees with the horizontal plane of the head.

In operating on the pituitary body by the intranasal route, it is often of considerable importance to know the distance of the anterior sphenoidal wall from a selected point on the tip of the nose and also the distance of the anterior from the posterior sphenoidal wall. I would suggest that this can be accurately measured by having the patient lie on his side, placing a lead marker, as a shot, on the tip of the nose, secured by a small piece of adhesive plaster and making a plate with the target of the *x*-ray tube at a known distance from the plate. The distance of the lead marker from the anterior wall of the sinus being measured and the distance of the target from the plate being known, the position and exact size of the sphenoidal boundaries can be calculated very accurately.

The number of cases of acromegaly which are now being studied makes frequent demands on the roentgenologist for the diagnosis of the condition of the sella turcica and the establishment of the integrity of the anterior and posterior clinoid processes. The increasing frequency of these cases renders an accurate study of the sphenoidal sinus of great importance in planning operative procedures.

Like the frontal sinus, the anatomy of the mastoid in the living can be studied by means of the Roentgen plate. The technic of the oblique exposure as developed by Lange gives the operating otologist a great deal of valuable information. The size and position of the lateral sinus can usually be definitely shown as well as the size and extent of the pneumatic cells

In the diagnosis of pathologic conditions of the mastoid, the Roentgen ray offers decided aid in addition to the more classic diagnostic measures. The technic, as advanced by Lange, is of the greatest value, but often it may be found somewhat difficult to obtain plates of the two sides with the penetration necessary to make decisive comparative study.

I would suggest a technic which in my hands has been found to be quite useful. It is not advanced, however, with any idea of supplanting the technic perfected by Lange, which affords us data as to the size and shape of the normal and pathologic mastoid. My technic affords simply a comparatively easy way by which one mastoid can be compared with its fellow as to the presence of fluid or granulation tissue.

The method of examination is as follows: The patient lies on his back with the plate under the immobilized head. A very small diaphragm is centered over one mastoid with the rays passing slightly obliquely, with the direction slightly toward the occiput. An exposure is made in this position on a large plate and then the tube-holder and diaphragm are shifted till they are centered over the opposite mastoid. The two resulting exposures are made on the same plate and as the time of exposure is comparatively short, it is very easy to get two exposures of about the same density. This shows at once whether the tip of the mastoid is filled with air or has undergone pathologic changes.

As was stated before, this technic for the investigation of the mastoid is not suggested with any idea that it will replace the lateral exposure; I feel, however, that it may be employed in suitable cases to check or corroborate the plates otherwise obtained.

Another use to which the Roentgen ray has been put in the study of otologic conditions is in determining the presence of an internal ear and auditory canal in children with congenital atresia. In a case of mine, the ear was deformed and there were no external evidences of the presence of an internal ear or bony canal. A plate made with the rays passing through the aural regions, however, so that the shadow of one side did not superimpose on the other, showed that there was a well-formed auditory canal as well as a definite internal ear. With such authoritative knowledge the question as to operation can be easily decided.

In considering the rôle of roentgenology in otolaryngology, we must remember that we are dealing with a diagnostic agent which should always be considered simply as an adjuvant and one which should not be used to the exclusion of other diagnostic measures. I consider it very wrong to hazard diagnoses simply on the plate alone. Such misuse of the Roentgen ray will serve in the long run only to cast discredit on its use.

In general, it may be stated that the basis for the interpretation of plates of the sinuses rests on the fact that the ray in passing through a bony cavity filled with air gives a contrasting outline which is sufficiently different from that obtained when the air is replaced by secretion or granulation tissue. In other words, we can tell if the pneumatic condition of the sinuses is intact. The roentgenologist should not be tempted too far beyond this basic fact in his diagnostic ardor.

Future study and collaboration between the otolaryngologist and roentgenologist will be followed by still more brilliant results. Coordinated team work will be fruitful of great good to the patient.

32 Adams Avenue, West.

ABSTRACT OF DISCUSSION

DR. SIDNEY LANGE, Cincinnati: As a roentgenologist I would not make an attempt to make a diagnosis, but simply report the findings to the otologist and let him draw the conclusions. In doing this work constantly I am impressed more and more with the accuracy of this method, and I see every day that there are a certain number of cases that cannot be accurately diagnosed or treated without the aid of an *x*-ray plate.

There is a type of case I often see in which there is discharge but no pain. Here the plate alone may be the deciding factor as to the origin of the discharge. In other cases there is pain about the face or head, and the diagnosis may depend entirely on the *x*-ray plate.

I have been especially interested in the mastoid work. I presented a paper before this Section several years ago and was then very conservative, but an experience of several years has given me much more confidence in the method. Unfortunately, it requires a large number of cases in order that the method may be accurately employed, by both the roentgenologist and the otologist. The otologist must persistently (not occasionally) use the method in order to know how to draw proper conclusions.

We are still adhering to the classification I gave to this Section several years ago in regard to mastoid disease; thus the plates may show a distinct mastoid outline, with clear crisp cell walls and clear interspaces, indicating a normal mastoid; first-degree mastoiditis as shown on the plate exhibits a haziness of the cells; the cells, instead of being air-

filled, are fluid-filled, but the cell walls are still distinct and crisp; second-degree mastoiditis shows softening of cell walls and cells filled with fluid; some of the cells may be destroyed; these cases usually require operation. Third-degree mastoiditis shows loss of structure of the mastoid. The chronic cases fall into two groups: sclerosis, which may be simple, showing nothing but solid bone, or which may be accompanied by bone defects. I have several slides showing hollowing out by cholesteatoma, only the shell of the mastoid remaining.

Dr. Hickey's original suggestion as to technic is a very valuable and helpful method, because often it is difficult to use this lateral method, especially in young children and in certain types of skulls in which the lie of the land is not favorable to getting the mastoid on the flat. His plates are, too, perhaps less difficult to interpret by one not familiar with the study of *x*-ray plates. Having the two mastoids on the same plate makes the diagnosis easier. The disadvantage is that his method shows chiefly the tip and gives no evidence of involvement of the antrum or superior part of the mastoid.

DR. C. F. WELTY, San Francisco: The most important thing I believe (and Dr. Hickey does not lay sufficient stress on it) is the relation of the antrum of Highmore to carious teeth that may project into it. Instead of taking an *x*-ray of the antrum, take an *x*-ray of the roots of the teeth and you often get very valuable information. Trouble in the antrum can be easily demonstrated by needle puncture. The indications for operation in acute cases are so well marked that with the experienced man there is no chance of a mistake, and in a chronic case there is even less chance for making an error. It matters little whether the sinus is far forward or far back, if you have a large cell or a small one. I made a mistake in a case of furunculosis in which the mastoid was free. Possibly if I had studied the case better operation would not have been done, but this is the only condition I know of in which the *x*-ray would have been of benefit in making a diagnosis of mastoiditis.

DR. W. W. CARTER, New York: Not very long ago I saw a patient who had ethmoiditis and involvement of the sphenoid, and there was a question of whether the antrum was serving as a reservoir for the pus. The patient objected to having the antrum explored with the needle and preferred to have an *x*-ray. He was sent to one of the most expert roentgenologists in New York, who made an excellent plate and pronounced both antra to be filled with pus. On his recommendation we submitted the patient to radical operation, opened the right antrum and found it absolutely normal; no pus whatever. The mucous membrane was not hypertrophied or thickened in any way, and when we found that condition on the right side we did not dare open the other. That was a case in which the opacity was caused by thickness of the walls of the antrum. I think the question of comparing the two sides is very important; it has been of great assistance to me.

DR. J. E. LOGAN, Kansas City, Mo.: The Roentgen ray has proved a great adjuvant to the rhinologist, and is destined to a much wider field of usefulness. In three cases of optic neuritis coming under my observation, the roentgenologist was able to demonstrate to me an excessive development of cell structure in the posterior portion of the ethmoidal body, extending above and external to the sphenoid. It is probable that in many cases of optic neuritis we shall be able to find pressure influences exerted on the trunk of the optic nerve by excessive development, together with pathologic changes in the posterior ethmoidal cells.

DR. WENDELL PHILLIPS, New York: I have had a considerable number of *x*-ray plates made of acute and chronic mastoiditis, and have made it a routine procedure in the last two or three months in my service at the Manhattan Eye and Ear to use *x*-rays in almost every case of mastoiditis, acute and chronic, and of all ages; it has given me extreme satisfaction and is a very interesting study. I deprecate the tendency with many men to place too much reliance on the *x*-ray plate to the detriment of our clinical symptoms. I do not employ the *x*-ray as a necessity, but as a valuable adjunct.

In one *x*-ray plate in the Manhattan Eye and Ear Hospital collection the outlines and location of a large accumulation of pus in the lateral sinus is distinctly shown, which condition was confirmed at operation. The benefit comes in outlining for the operator the existing anatomic conditions. It gives a distinct knowledge regarding location and size of the lateral sinus, and shows whether you have a pneumatic mastoid or not. A good plate, always taking both sides, is of great value.

DR. OTTO GLOGAU, New York: I should like to mention one case, that of a young girl, suffering for years with pain in the supra-orbital region, middle turbinate hypertrophy, and slight discharge from the middle meatus of the nose. I thought it might be a hyperplastic ethmoiditis, combined with frontal sinusitis. The *x*-ray showed darkness over the frontal sinus. I did a Killian and found no sinus present. It turned out to be supra-orbital neuralgia. In another case there was marked swelling both above and below the eye in an old lady, pain in the supra-orbital region and pus below the middle turbinate. A radiograph showed darkness over the antrum and over the frontal region. I operated on the frontal sinus and there was no sinus present. The trouble was in the antrum exclusively. Thus in some cases in which the *x*-ray picture shows darkness there may be no sinus present.

DR. MAX GOLDSTEIN, St. Louis: Negative *x*-ray findings may often be of considerable importance. As a factor in examination, negative *x*-ray findings may be as essential as negative results in the examination of tuberculous sputum. The finding of the tubercle bacillus is positive evidence of tuberculosis; the absence of the tubercle bacillus in the examined specimen of sputum, however, does not necessarily justify the conclusion that there is no tuberculosis. The same relative condition obtains as far as radiograms are concerned. If we have a definite shadow, outline or other tangible landmarks in radiography, we may infer the presence of pus or other fluid, granulations, anomalous anatomic relations, etc.; a negative *x*-ray picture in my opinion, however, does not exclude the possibility of an existing pathologic condition.

DR. G. F. COTT, Buffalo: I had an experience lately which would demonstrate the importance of the *x*-ray. A girl, 13 years of age, had a swollen jaw. Her physician found that she was blind in one eye. I was called in, had her taken to the hospital, opened the antrum and found a quantity of pus. I intended to open the frontal sinus also, although not having an *x*-ray picture at the time. I worked away until I felt that I was near the danger point and stopped. The child recovered in a few weeks, and we then had an *x*-ray picture made. We found that she had no frontal sinuses. In that case it would have been very valuable to have had an *x*-ray picture taken before the operation, but it was very necessary to act quickly.

DR. B. R. SHURLY, Detroit: I have a case in mind which showed that this modern method offered us something that was absolutely unknown heretofore, as a method of differentiation in some of our more difficult cases of frontal sinus disease. This patient was suffering from necrosis of the anterior wall of the frontal sinus, which gave, by ordinary methods of diagnosis, absolutely no indication whatever of the trouble. On examination with the *x*-ray we were able to make a diagnosis of necrosis of the wall, although the history was absolutely negative. A radical operation gave immediate relief. The mapping out of the frontal sinus before operation is an exceedingly valuable aid, and this applies, of course, to the sinus in the mastoid, outlines which we can so readily obtain by this *x*-ray method.

DR. P. M. HICKEY, Detroit: We are dealing with one of the newer aids to diagnosis. Not everything is yet known about it, and undoubtedly many wrong interpretations have been made and will continue to be made, though we hope they will become fewer and fewer. It seems to me that the field under discussion is one which can extend over into the border of otolaryngology for the benefit of the patient and that the accuracy of this method lies in the correct interpretation of the plates. We are perhaps too apt to think that when the plates have been taken there is the end to the work. I think that the whole field of work is in the interpretation of the plates. One can train one's office girl to make the plates; that is a simple matter of technic, but the deduction of proper conclusions from them is the great field of study.

THE OPERATIVE TREATMENT OF BRAIN ABSCESS OF OTITIC ORIGIN

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In dealing with the subject assigned to me in this symposium I shall detail the methods used by me in operating on and treating brain abscess complicating purulent middle-ear disease.

As most of the abscesses the otologist sees occur after a mastoid or middle-ear operation has been done, this type will be discussed first.

When a brain abscess is suspected following one or both of the above conditions and we find a stalk —"the pathway of infection"— leading from the tympanic cavity, aditus or roof of the mastoid antrum, it becomes a comparatively easy task to localize the pus collection by tracing the so-called stalk up to the abscess cavity, by director, knife or long narrow forceps; and when the pus is encountered, enlarging the original pathway of infection by cutting down on it from its dural entrance to the abscess cavity and wiping the cavity gently with sterile strips of gauze soaked in a warm normal salt solution. The introduction of a drainage tube at the lowest point of the abscess cavity and the application of a soft gauze dressing is about all that is usually necessary.

When, however, we suspect an abscess and there is no visible pathway of infection present leading from any of the above locations, the procedure is not so simple.

When the abscess is suspected in the temporosphenoidal lobe, a sufficiently large button of bone should be removed over the roof of the aditus, or overlapping both the adital roof and a portion of the tegmen antri to enable one to explore with ease the entire temporosphenoidal region. The otologist, in the past, has been criticized, and justly, by the general surgeon for making these openings too small to admit of thorough and satisfactory exploration.

The dura is incised in the horizontal plane and fine silk sutures are introduced through its edges. The sutures can be used during the brain exploration as retractors, by gently drawing on them above and below, thereby exposing sufficiently the cerebral substance, and should the exploration prove negative, the dural edges can be approximated and sutured by the silk already in position, thereby preventing a hernia of the cerebral substance.

METHOD OF EXPLORATION

For exploring the brain substance itself, it has been my custom to use a long slender bladed knife, introducing it at first forward, downward and inward for about 1 inch, provided pus is not encountered before, in the region of the tegmen tympani. Should the exploration be negative, the knife is then introduced directly upward and inward for about 1 inch, the introduction being directly through the same opening as that already made. Should this again prove negative, a third exploration can be made in the same manner and depth, backward, downward and inward. Should these three locations prove negative, others can be made in various directions, always starting from the original opening in the brain first. I have made as many as twelve explorations of the temporosphenoidal lobe through such an opening with a slender bladed knife in a search for a brain abscess, which proved negative, and closed the dural flaps in the manner described, with but little or no discomfort to the patient.

Should an abscess cavity be encountered by the knife, it should be left in position and a long narrow bladed forceps passed gently along the knife blade until it reaches a little beyond the point of the knife, which can be easily determined by the tactile sense. The forceps blades can then be gently separated and either the encephaloscope passed between them or a pair of long flat metal retractors. I am inclined to use the retractors rather than the encephaloscope at this stage, because less pressure is exerted on the brain tissue. The cavity should be wiped out as gently and quickly as possible with gauze moistened with a warm saline solution.

It is not necessary to remove every visible evidence of pus with the gauze, for too frequent or active manipulations are detrimental to the best interests of the patient, on account of the danger of opening up new avenues for further brain infection. It is my belief that many so-called multiple and secondary brain abscesses are produced by too energetic endeavors to remove the primary pus collections, thereby injuring the adjacent brain tissue and allowing new foci to form.

DRAINAGE

This is a most important adjunct in the treatment of brain abscesses. If the abscess be one of long standing with a limiting membranous wall, a large rubber drainage tube should be introduced, as the mechanical pressure produced by the tube on the limiting membranous wall hastens resolution. If there be no limiting membrane present and the abscess be of the acute type, then I believe that drainage is better conserved by using a moderate-sized cigarette drain, than by using rubber tubing. In either case, the upper end of the drain should not be placed flush with the cerebral substance, or against the limiting membrane when present, but a small space should intervene to allow for a collapse of the brain substance.

DRESSING

Quantities of soft fluffy gauze should be placed around the distal end of the drain and a loose bandage applied.

Subsequent dressings should not be too frequent — once in three or four days — as too frequent inspection and manipulation delay resolution. At each dressing, the tube or drain should be gently drawn out for a fraction of an inch and cut off. For subsequent inspection of the cavity the encephaloscope is helpful as it allows one to see the condition of the walls and the removal of detritus and discharge is easily accomplished. Long slender metal retractors can, however, be used to advantage.

A slow, gradual or sudden rise of temperature, or a change in the mentality of the patient is indicative of obstruction to the drainage, and when this occurs the cavity should always be inspected in an effort to discover the obstruction, or the development of adjacent foci. An unfavorable postoperative temperature or a marked change in the mental condition of the patient may also be caused by the onset of a meningitis or encephalitis. The position of the patients after operation is of importance. They should be made to lie on the affected side, as much as possible, for the first few days following operation and later the head should be elevated to promote drainage.

SUSPECTED BRAIN ABSCESSES

In suspected brain abscesses, when the symptoms are not urgent enough to call for an immediate operation, the technic for opening the abscess, as advised by

Ballance has met with excellent results. It consists briefly in making a free exposure of the dura, incising it and separating the flaps sufficiently for exploratory purposes, applying a dressing and waiting for from twenty-four to forty-eight hours. This relieves any urgent pressure symptoms, and if pus be present and under any considerable pressure it will take the line of least resistance which is toward the dural opening and can be reached more easily and surely when the brain tissue is incised. It has another advantage, and to me it would seem a most important one, that of minimizing the occurrence of a secondary meningitis by allowing the severed edges of the dura to become plastically sealed, thereby shutting off the possibility of absorption as would be probable when pus came in contact with the freshly severed edges of the dura. At the end of from twenty-four to forty-eight hours after this modified decompression has been done, a knife is introduced into the brain substance after the manner above described and the pus, if present, evacuated. To me, this procedure seems rational and practical, especially if the case be not an urgent one. That secondary meningitis is often the fatal outcome of these cases there can be no question, and anything that will diminish its frequency will be welcomed by the surgeon.

CEREBELLAR ABSCESS

Abscesses of the cerebellum are evacuated almost always posterior to the descending limb of the sigmoid sinus. The technic for this exposure and exploration is largely the same as that discussed for temporosphenoidal abscess. One point of special importance should be borne in mind in evacuating and draining abscesses in this region and that is that the opening in the cerebellum should be sufficiently low down to admit of free drainage. Frequently after an abscess has been opened in this region, the site of which has been in the upper and lateral structure of the lobe, the surgeon has completed his operation without sufficient drainage from below, overlooking the mechanical fact that the cavity in order to drain must first fill up from the bottom to a level with the drainage inserted above.

When one enters the brain for an exploration of abscess, without the middle ear or mastoid having first been surgically attacked, the site of election may be over any point of the temporosphenoidal lobe or cerebellum. The technic for the dural exposure and brain exploration is the same as that already discussed.

CONCLUSIONS

In acute and emergency cases operate early, doing the entire operation at one sitting.

In subacute cases and those cases not urgent, the modified decompression operation with a wait of from twenty-four to forty-eight hours after the dural incision before exploring the brain, conserves the best interest of the patient and minimizes the development of secondary meningitis.

A large opening in the skull is essential. If at point of election and a negative result is obtained the bone button can be replaced. Dural sutures aid materially as flap retractors and should the exploration be negative the brain substance can be covered and protected by tying the sutures. If pus is encountered removal of the sutures follows.

The knife only is to be used for incising brain tissue; avoid finger manipulation and trauma to surrounding substance. Wipe the cavity gently; no irrigation should be used unless in a chronic abscess cavity with distinct and dense limiting membranous wall. The size of drainage tube should be governed by the extent of the cavity; the material used is rubber tubing in the chronic variety and cigarette drain in the acute type.

Rise of temperature or change in mentality of the patient calls for an immediate inspection of the cavity, with search for obstructed drainage or development of additional foci.

Rapidity in operation is essential to success, and above all frequent manipulation of brain substance should be avoided.

62 West Sixty-Second Street.

DIAGNOSIS AND LOCALIZATION OF BRAIN ABSCESS *

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DIAGNOSIS

The diagnosis of brain abscess, I need hardly say, is often extremely difficult. We are confronted at the outset in the average case with a compound of symptoms pointing, in part, to some extracranial surgical condition, such as disease of the middle ear, and in part to a lesion within the cranium. That the symptoms of the latter are often extremely vague and indefinite, even when subsequent autopsy reveals gross lesions of the brain, of its membranes or sinuses, every one who has had practical experience in this field will admit. Evidently in a suspected case of brain abscess the first step must always be the search for symptoms indicative of actual intracranial lesion. We will suppose, for instance, that an examination of an ear has clearly established the existence of an infection or that the condition of the ear and the medical history justify the inference of the existence of such an infection in the past. We must remember that brain abscess often presents a latent period extending over many months and years, so that the condition of the ear which originally gave rise to an abscess may have completely and long ago subsided at the time that the abscess makes itself manifest; but we will suppose that positive evidence of an otitis past or present has been established, and that at the time the patient comes under observation, certain other symptoms —certain new symptoms—have made their appearance—symptoms now suggestive of intracranial lesion. What are these symptoms? Frequently we are told that the patient, who had been previously well—at least in whom nothing unusual had been observed—began to suffer suddenly from headache and vomiting. Less frequently do we find that these symptoms, particularly the headache, have supervened gradually; most frequently we are confronted by symptoms suggestive of a pathologic condition that is acute or has suddenly become active. When we talk with the patient, we are also impressed by the fact that he is somewhat dull, heavy and apathetic, sometimes markedly so; and we may therefore say that, in addition to the headache and vomiting, hebetude in some degree is also present.

That the symptoms of headache, vomiting and hebetude may be but slightly pronounced and, notwithstanding, serious brain mischief exist, is well established. In estimating the value of these symptoms, even when slight, we must bear in mind the fact that brain abscess is often

* Because of lack of space, this article is abbreviated in THE JOURNAL. The complete article appears in the Transactions of the Section and in the author's reprints.

quiescent and latent for many years. As is well known, a brain abscess, the symptoms of which become manifest in adult life, may have had its inception in an ear disease of childhood. If the abscess be well encapsulated, the brain becomes singularly tolerant of its presence and it would appear that it is only when some untoward incident arises — usually something so slight as to escape notice — or at times without traceable incident of any kind, that active symptoms manifest themselves.

Granting that headache, vomiting and hebetude make their appearance, these symptoms of themselves do not justify the diagnosis of intracranial disease. Every otologist will, I think, bear witness to the fact that these symptoms may be encountered in cases of acute and uncomplicated otitis media or in cases of chronic otitis with exacerbations and pus retention. At least these symptoms have been known time and again to disappear after paracentesis or other radical operation. The question arises, are there other symptoms added to the triad we have mentioned, the presence of which will permit a definite conclusion? Certainly the presence of dizziness will not help us, and this is true also of the presence of fever. How as to the presence of optic neuritis? While optic neuritis usually justifies the inference of intracranial involvement, it apparently does not always do so.† At least this is the experience of several observers, among them Jansen and Roughton. This, however, is so unusual that it becomes significant only when the optic neuritis disappears after operation limited to the ear. If, on the other hand, an optic neuritis persists after such an operation, the inference becomes unavoidable that the optic neuritis indicates an intracranial involvement. I am inclined to believe that the occurrence of optic neuritis always indicates an intracranial involvement, though that involvement may be slight in degree. Certainly the fact that such a symptom may subside after an operation limited to the ear and in which neither the cranial cavity nor the membranes are invaded by the surgeon, does not justify the inference that no intracranial involvement was present. Similar is it with regard to other symptoms which have been known to disappear after purely aural operations; among these may be mentioned palsy of the sixth nerve, inequality of the pupils, diplopia and ptosis. Here we are again warranted in inferring that the drainage and revulsion resulting from the operation are really accountable for the disappearance of the symptoms. Ordinarily such symptoms may be accepted at their face value, namely, as indicating intracranial involvement. It should be added that neuroretinitis, if associated with other symptoms, may also be significant. It has been repeatedly observed. Potts,[1] indeed, regards it as one of the cardinal symptoms of brain abscess.

To the general symptoms of headache and vomiting, we should also add that of slow pulse which is frequently, though, of course, not invariably, present in brain abscess as it is in brain tumor. Sometimes it is very pronounced. Such slowing of pulse may be present in spite of fever; at other times it may be replaced by a rapid pulse, especially if fever be marked.

Having completed the first step of the diagnosis, namely, that of intracranial involvement, it next becomes necessary to determine the nature of the involvement. Here we are obliged to differentiate between the following conditions: first, external purulent pachymeningitis, i. e., supradural abscess; second, thrombosis of the lateral and other sinuses; third, purulent meningitis limited or diffuse; fourth, purulent meningo-encephalitis; fifth, non-suppurative localized encephalitis; sixth, serous meningitis; seventh, brain abscess.

Supradural abscess — external purulent pachymeningitis—is beyond all doubt the most frequent intracranial complication of otitis. While it may simulate brain abscess, we should bear in mind that it does not present the focal symptoms frequently present in the latter, while there are often present pain on pressure back of the mastoid, often swelling in this region as well as a tendency to hold the head in a fixed position. Finally, the fact of extradural involvement becomes in many cases apparent in the course of a radical or exploratory operation.

The consideration of thrombosis of the lateral and other sinuses would take us too far afield. Suffice it to say that involvement of the lateral sinus is especially indicated by venous fulness and edema back of the ear in the mastoid and occipital regions. In addition, there is a decided tenderness over the edematous area, especially over the mastoid foramen. Again the external jugular vein on the affected side is less full than its fellow, the difference becoming especially evident on efforts at inspiration. Occasionally, the thrombosis extending into the internal jugular vein, the latter may be felt as a firm and painful cord. In short, there are local symptoms present which are not met with in uncomplicated brain abscess.

Purulent meningitis is differentiated with greater difficulty. If the meningitis is diffuse, however, the symptoms are of such a character as to make the differentiation comparatively simple. We need only think of the retraction of the head and neck, the involvement of cranial nerves on both sides and the numerous other symptoms present in such a case. It is only when the meningitis is limited or circumscribed that the differentiation becomes difficult. It is usually impossible to say whether a brain abscess is or is not complicated by a local meningitis. In doubtful cases we may resort to lumbar puncture, but unless the meningitis be in a degree at least diffuse, no information may be gained. In a diffuse purulent meningitis, the fluid obtained is rich in cells and bacteria; but a slight cloudiness of the fluid and the presence of some bacteria do not justify the diagnosis of a meningitis save, perhaps, such as may result from the abscess impinging or encroaching on a limited area of the pia. In my own experience, the necessity of differentiating between brain abscess and diffuse purulent meningitis has rarely arisen. This is true also of limited purulent meningitis; in the latter the differentiation was on the whole impracticable.

If the purulent inflammation involves not only the pia, but also the subjacent cerebral tissue, i. e., if there be present a purulent meningo-encephalitis — a subdural abscess, in other words — the symptoms may be practically the same as those of simple brain abscess. The fact that subdural abscess more frequently involves the temporal lobe than the cerebellum does not materially aid the diagnosis. As showing the practical conditions that may be found and as indicating the inutility of always attempting a sharp differentiation, the case reported by Amberg[2] may be cited, in which there were present at one and the same time, extradural and intradural abscess, sinus thrombosis and brain abscess.

We should bear in mind, also, in considering the possibility of brain abscess in a given case, that a non-suppurative localized encephalitis may occur. Its rela-

† See also Risley, Jour. Nerv. and Ment. Dis., Jan. 22, 1909.

1. Potts: Am. Jour. Med. Sc., 1907, cxxxiv, 113.

2. Amberg: THE JOURNAL A. M. A., Aug. 22, 1908, p. 667.

tions to ear disease are, however, generally less direct and clear. As Oppenheim points out, it more frequently involves the frontal and central regions and corresponding symptoms make their appearance. It may, however, involve a temporal lobe and in such instance, especially if it occurs on the left side, it may simulate brain abscess in this region.

The differential diagnosis of abscess from serous meningitis is of considerable importance because serous meningitis may itself result from otitis. The symptoms of serous meningitis are those of a diffuse involvement while optic neuritis is usually an early and a pronounced symptom. The symptoms are relatively mild both as regards the temperature and as regards the physical signs; of course, weakness of the extremities, involvement of cranial nerves and other local symptoms may be present, but they are not so clearly marked as in other forms of meningitis.

Having briefly passed in review the various conditions other than brain abscess, let us now give our attention in detail to the latter affection. A brain abscess may, as we know, run its course in a few hours or days; this it does very exceptionally. On the other hand, it may endure for many years. It may complicate the picture of an acute disease of the middle ear or of an exacerbation of a previously existing disease of this organ. In such case the symptoms added to those of the ear affection may be of such a character as to raise little more than a suspicion of intracranial mischief. Thus there may be fever, headache, vomiting and hebetude, all symptoms which, as we have seen, may be present in disease limited entirely to the ear. Frequently, indeed, the symptoms are such as not to raise the suspicion of intracranial involvement; thus the acute symptoms both of the ear and of possible brain involvement may subside, and the abscess, if really established, passes into a latent stage. Sometimes we will, in a suspected case, learn that during such a supposed latent period the patient has at times complained of headache, but that this headache was not regarded seriously; sometimes that slight and evanescent fever was present, to which likewise no special attention was given. It may be, again, that the patient is observed to be in ill health, that he has lost weight and strength, that he has become apathetic, slightly depressed, a little slow mentally or even slightly confused. As a rule, however, symptoms are entirely absent during the latent period. It appears that the abscess becomes encapsulated at an early stage and thus quiescent. How tolerant the brain may become to an encapsulated abscess, even when the latter is very large, many can testify.

There is one point, however, which it is especially important to bear in mind, and that is that if in a case of disease of the ear — whether the latter be still active or whether it has apparently terminated in recovery — convulsions make their appearance, the suspicion of otitic brain disease should at once be aroused. The convulsions may resemble ordinary epilepsy or they may depart from the typical symptoms of the latter. Thus loss of consciousness may not be complete, or during the seizure rigidity of the muscles rather than clonic movements may be noted; indeed, because of these features hysteria has now and then been diagnosticated in cases in which the patient in reality suffered from brain abscess. If in a case of ear disease, therefore, convulsions supervene, the case should be submitted to elaborate study.

We will suppose that in a given case the latent period has terminated and that from some undetermined cause the brain abscess has become active; what are the symptoms?

1. Headache, sometimes slight, sometimes intense in degree. Sometimes it is diffuse; at times, referred to a site corresponding to the abscess. Very rarely, it is referred to a distant region, e. g., to the opposite side of the head. Sometimes percussion of the skull increases it or evokes it if absent. Rarely local tenderness is elicited. As a rule the headache is made worse by vomiting or by muscular effort.

2. Vomiting. This is quite common, but may be but slightly pronounced. It is especially frequent in cerebellar abscess.

3. Dizziness. Though present at times, dizziness is much less frequent than headache or vomiting. When pronounced or when present in the form of a well-defined vertigo, it should be carefully investigated.

4. Hebetude. The mental state is seldom entirely normal. Usually there is present a certain degree of slowness of thought and of apprehension; at times of apathy and depression. The mental symptoms may be very slight or may be so pronounced as to amount to stupor. Very pronounced mental symptoms are, however, usually present only in the terminal stages. In some cases there are present restlessness, irritability, confusion or delirium.

5. Fever. This, as is well known, may be entirely wanting. In fact, the temperature may be subnormal; indeed, this appears to occur in about one-third of the cases. Special stress has been laid on this fact by Macewen. There is never a high temperature in uncomplicated cases. When temperature is noted, it is usually moderate in degree and may be present only toward the evenings. It is not improbable that when fever is present in a degree, the abscess has impinged on the meninges or that possibly other complications are present. Certainly high fever occurs only when the abscess has actually opened into the meninges or, perhaps, into the ventricles. That rigors may be noted under such circumstances goes without saying.

6. Optic neuritis and choked disk. Optic neuritis is not nearly so frequent in brain abscess as in brain tumor. Oppenheim and Cassirer have estimated that changes occur in the papilla in about 53 per cent. of the cases. We must make a distinction, however, between optic neuritis and choked disk; the one apparently results from the toxicity of the abscess, the other from the increased intracranial pressure. Their relative frequency is well indicated by Okada (quoted by Lewandowsky), who found in ninety-six cases of cerebellar abscess optic neuritis in twenty-two and choked disk in only seven. It is important, also, to bear in mind that, more frequently than in tumor, the optic neuritis is limited to one side, usually on the same side as the abscess, though sometimes on the opposite side.

While brain abscess, like brain tumor, may be attended by the symptoms of increased intracranial pressure, it is not improbable, as Lewandowsky points out, that the general symptoms of brain abscess are, in part at least, dependent on the action of the toxic substances of the brain abscess. Not only is it probable that the psychic symptoms are due to such an intoxication, but even at times also the headache and vomiting; certainly it is the most plausible explanation of the presence of optic neuritis, which, as we have just seen, is far more frequent than choked disk.

If we attempt to summarize the more important symptoms pointing to a brain abscess, i. e., an abscess that has entered on an active stage, we may enumerate them briefly as follows: headache, vomiting, dizziness, hebetude, subnormal temperature or moderate fever, optic neuritis, neuroretinitis, choked disk. These symptoms have additional significance if an examination of the cerebrospinal fluid proves negative. Should a blood examination reveal a high leukocytosis, this is of course also of value.

LOCALIZATION

The important differentiation in otitic abscess is of course between temporal and cerebellar involvement. To begin, symptoms pointing to such differentiation may be entirely absent. A circumscribed abscess may exist in any portion of the brain without evolving localizing symptoms, so tolerant may the brain become to its presence especially during the period of latency. In the majority of cases, however, symptoms are present, though they are often exceedingly slight. They necessarily depend on the extent of the abscess and the degree of involvement of structures producing definite reactions.

In involvement of the temporal lobe, the abscess is mainly, though of course not always, basal. Time and again because of the basal situation, cases are encountered in which no very definite localizing symptoms are present. If the abscess be sufficiently extensive and deep, however, it may by pressure on or involvement of the basal ganglia or internal capsule give rise to weakness of the arm and leg of the opposite side, frequently associated with spasms or convulsions. Hemianesthesia and at times hemihypalgesia of the opposite side have been noted; sometimes conjugate deviation of the head and eyes; sometimes hemianopsia. All of these symptoms may be wanting, however, and yet temporal abscess be present and extensive.

When the abscess involves the left temporal lobe, and provided that it be sufficiently extensive, sensory aphasic symptoms may be present. These symptoms may be very slight, but if present in any degree are significant. Thus a certain amount of word deafness may be noted; in some cases merely a moderate difficulty in understanding what is said. The involvement of the superior temporal convolution or of its subjacent white matter may be very slight, but there may be present a partial amnesic aphasia or possibly a paraphasia; at times also an inability to name objects, as in a case reported by Macewen.[3] The speech involvement may not be clearly defined or pronounced, though it may be obviously present. Other speech defects, such as alexia and agraphia, have also been noted, though infrequently.

In abscess of the right temporal lobe, aphasic symptoms are absent, though, it would appear, not invariably so. Sometimes the absence of definite symptoms in right temporal abscess is very pronounced. In a case described by Levy[4] the diagnosis of sinus thrombosis had been formed and yet the autopsy revealed a right temporal abscess while the sinus showed no involvement.

Cranial nerve involvement may also be noted in temporal abscess; especially is this true of the oculomotor nerve. Not infrequently there is ptosis; less frequently, also, dilated pupil or external strabismus. Sometimes there is involvement of the sixth nerve. Exophthalmos also has been noted.

Anosmia, homolateral, has been repeatedly observed in temporal abscess. In a case reported by Raimist,[5] it was clearly in relation with the abscess.

In cerebellar abscess vomiting is apt to be more marked than in temporal abscess and there may be rigidity of the muscles of the back of the neck or a tendency to hold the head in a fixed position. The headache is usually occipital, but it may be frontal, as in the case reported by Sieur.[6] Typical symptoms of interference with the vermiform process are most frequently entirely wanting, owing doubtless to the fact that the abscess is almost always limited to the lateral lobe; curiously enough, too, in cases in which the vermiform process has been involved, such symptoms have occasionally likewise been wanting. If present, the symptoms are rarely marked. Cerebellar ataxia, which may be one-sided, has been noted, however. Of late years Babinski has called attention to a number of symptoms which may be present when the cerebellum is diseased. These symptoms are exceedingly important and should be sought for, I believe, also in suspected cerebellar abscess. Among these is asynergia. This may be demonstrated in various ways; thus the patient when walking allows his body to remain to some extent behind the legs, that is, the trunk is thrown backward and in progression seems to be retarded.

Further, if the patient, being seated, makes an attempt to rise without the assistance of his arms, the trunk and the thighs become flexed, the legs becoming extended. Lastly, and perhaps most important, if the patient attempts to touch an object with his foot, the movements do not occur simultaneously in the knee- and hip-joints, but follow in sequence, first in one joint and then in the other. The symptom, when it is limited to one side of the body, is termed hemiasynergia and is homolateral, i. e., exists on the same side as the lesion.

Babinski has also noted in cerebellar disease an inability on the part of the patient to follow one group of muscle innervation rapidly or normally by another; for instance, he finds that the patient is unable to change quickly from pronation of the hand and forearm to supination. Like the hemiasynergia, it is a homolateral symptom. He has given it the rather unfortunate name of adiadochokinesis. Finally, sometimes in cerebellar abscess we note a tendency of the patient to turn or to fall to one side in walking; the tendency is most frequently to turn or fall to the opposite side, though sometimes to the same side.

Incoordination is occasionally also encountered both in temporal and in frontal abscess, but it is not improbable that the symptoms more especially brought to light by Babinski will in the future aid us in making the differentiation. The symptoms, it should be remembered, are of value if they are clearly marked and present early.

The presence of dizziness or vertigo in a given case always merits serious consideration. The symptom is frequently very difficult of interpretation. To begin with, however, it may be stated that if it be merely subjective, i. e., does not betray itself by any outward manifestation and be variable and inconstant, it may be disregarded. Under such circumstances it can have no localizing value. If pronounced, it may suggest disease of the labyrinth, involvement of the vestibular nerve or possibly disease of the nucleus of origin of the latter.‡

3. Macewen: Lancet, London, 1910, i, 1533.
4. Levy: Deutsch. med. Wchnschr., 1909, No. 8, p. 340.
5. Raimist: Arch. f. Psychiat., 1909, xlvi 127.
6. Sieur: Arch. internat. de Laryng., 1910.
‡ See also Bárány, Handbuch der Neurologie, i, 941.

Similar is it with nystagmus. Nystagmus also must be pronounced and indubitable to have value; we must remember, first, that nystagmus has been observed in temporal lobe cases and no doubt at times is to be ascribed to labyrinthine involvement, itself the result of the infection of the ear. The differential diagnosis between a nystagmus and vertigo due to disease of the labyrinth and of the same symptoms due to brain lesion is exceedingly difficult; indeed, often impossible. Surgically it would probably be of little value, for an exploratory operation would hardly be limited to the ear.

Choked disk may have the same significance as in cerebellar tumor, namely, it may be pronounced and attended by early loss of vision, though, as already pointed out, it is much less frequent than in tumor. Occasionally in given cases, also a hint as to the location of the abscess in the posterior cranial fossa is given by the presence of symptoms pointing to involvement of the pons or medulla.

Diminution of the corneal reflex is of course a symptom which, it should be added, is not infrequently observed in cerebellar abscess.

Pressure on the pons, the quadrigeminal bodies, the medulla and on the cranial nerves may produce special symptoms; among them, eye palsies, nystagmus, paresis of the facial nerve, dysarthria, pain and hypesthesia in the trigeminal distribution and disturbances of the respiration. At times, also, hemiparesis is present in cerebellar abscess. Occasionally pressure on the crossed pyramidal tract may give rise to spastic phenomena: plus knee-jerks, ankle-clonus, Babinski sign, etc. In a few cases, Macewen and Mueller have noted absence of the knee-jerks.

Statistics as regards the frequency of cerebellar and temporal abscesses give us but little aid in the study of individual cases. Those of Heiman,[9] however, which are well known, are exceedingly interesting. Heiman collected reports of 819 cases, of which he found 645 adapted to statistical study. In these cases, abscess was found 456 times in the cerebrum, 188 times in the cerebellum and once in the pons. Cerebellar and cerebral abscesses occur most frequently in the third decade of life. Otitic brain abscess occurs two or three times more frequently in the male sex than in the female sex. Cerebral abscess, as we have seen, is from two to three times more frequent than cerebellar abscess. It cannot be said that either of the two hemispheres of the cerebellum or cerebrum is more inclined to abscess than the other.

When we pass in review the various difficulties which enter into the diagnosis of cerebral abscess, it would seem justifiable to make use, at least in doubtful cases, of surgical exploration. The surgical procedures should, when all is said and done, in my judgment, follow largely surgical indications. The surgical indications are determined, in part, by a study of the diseased ear and, in part, by the conditions revealed in the successive steps of the operation. As a matter of necessity, it would seem that every operation must be, in part at least, exploratory.

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9. Heiman: Arch. f. Ohrenheilk., 1906, lxvii, 1.

Cost of Alcohol.—Alcoholic beverages, for which over $2,000,000,000 are spent yearly in the United States, cause over one-tenth of the deaths.—B. C. Keister before the Medical Society of Virginia.

DISEASES OF THE EAR WHICH LEAD TO BRAIN ABSCESS

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In every important pathologic cycle there is a focal point from which the disease process emanates and radiates. There is no small individual cavity in the human body which occupies so distinctly vital a position in its relations to surrounding areas as does the cavum tympanum. A brief study of its anatomic relations will definitely reveal the close interrelation which exists between the cavum tympanum and its many accessory areas, viz.: the eustachian tube, the mastoid antrum, the lateral sinus, the carotid canal, the labyrinth and the temporosphenoidal fossa.

The irregularly shaped cavity of the middle ear is located in a comparatively inaccessible place in the depth of the temporal bone, surrounded on all sides by delicate and vital structures. It offers a favorable site for fluid contents and an ideal incubator for the many forms of bacteria which so frequently find lodgment there. It is most vulnerable, of course, by way of the eustachian tube.

Infective and suppurative processes of the middle-ear cavity *via* the nasopharynx and eustachian tube route are variously estimated at from 80 to 90 per cent. of all suppurative middle-ear diseases. Anatomically, the tympanic cavity and the adjacent cellular bone areas of the mastoid may be regarded as an accessory space to the upper respiratory tract. The invasion of the tympanic cavity through the eustachian tube, following an infection or suppurative process of the nose, nasopharynx or buccal cavity is as frequent as is the invasion of the accessory sinuses of the nose through their natural ducts and ostia. When we add to this the histologic data of continuity of surface of the mucous membrane we can readily appreciate the enormous percentage of secondary infections of the tympanic cavity from infected fossa in the upper respiratory tract and the frequency with which these pathologic conditions occur

Mechanical forces may also be considered as factors in the production of suppurative processes in the middle-ear cavity. The short and straight eustachian tube in the child is readily conceded to be one of the important causes for the frequency of middle-ear infections in childhood; the contiguity of the mucous membrane lining the nasopharynx, eustachian tube and cavum tympanum is also a vital feature in the frequency with which middle-ear diseases occur as sequelæ following the anginas and acute infectious inroads of the mucosa in the exanthemas. The use of nasal douches, violent blowing of the nose and even the ordinary physiologic acts of sneezing, coughing and deglutition are frequently aids to the forcing of infectious material through the eustachian tube into the cavum tympanum.

In summing up the various factors which contribute to invasions by pathogenic microorganisms of the cavum tympanum we must not fail to mention the lymphatic and vascular connections between the nasopharyngeal areas and the lymphatic ring of Waldeyer with the cavum tympanum.

Conceding the many points of vulnerability to bacterial invasion of the tympanic cavity from the upper respiratory tract, our next step is to trace the further development of the various types of pathogenic bacteria which find their way into the cavum tympanum.

Suppurative otitis media is simply a generic classification of the many varieties of pus-producers which may invade the middle-ear cavity On the virulence or activity of the specific coccus or bacillus responsible for this suppurative process will depend the frequency, severity and rapidity of extension of such an active destructive process into the surrounding vital intracranial tissues.

The shape and small capacity of the cavum tympanum admits of but a small quantity of fluid contents, as scarcely eight or ten drops of fluid will completely fill it. As serous exudates and pus accumulation are sometimes developed in a few hours with astounding volume, a fluid or semifluid accumulation in the middle-ear cavity must find a natural vent. The only two normal connecting areas with the cavum tympanum are the eustachian tube and the aditus ad antrum.

In active and acute infections in which pus has found its way into the middle-ear cavity *via* the eustachian tube, its drainage by this natural channel into the nasopharynx is usually cut off because of the swollen and inflamed character of the mucosa lining the tube and consequently blocking its lumen. As the fluid contents of the middle-ear cavity increase in quantity, the only other natural avenue of escape is by welling up into the attic and through the aditus into the mastoid antrum and its surrounding honeycomb of cells. If the mucosa that lines the tympanic cavity, the aditus and adjacent areas of the antrum and mastoid cells is also swollen similarly to that of the eustachian tube, it may offer a considerable resistance to the escape of pus or other pathologic fluid into the antrum and another exit for the accumulated fluid contents must be mechanically found. This usually proves to be the *locus minoris resistentiæ* in the membrana tympani which bulges intensely outward by the increasing pressure of the fluid behind it, and if not relieved by the surgeon's knife, forces an opening in the membrana by which the fluid contents of the tympanic cavity can drain into the external auditory canal.

Let us assume in another instance that the pathologic pus-producing focus in the middle-ear cavity is due to a *Streptococcus pyogenes* or bacillus of influenza, that the two natural avenues of fluid escape (the eustachian tube and the aditus ad antrum) are eventually blocked because of the intense plastic exudate and swelling of the mucosa and that the membrana tympani is unusually resisting and strong in structure, and what would be the result?

Another of the vulnerable areas is now attacked: the tegmen tympani. Anatomists and pathologists have often marveled at the fact that the temporosphenoidal cranial fossa is guarded from invasion, injury and infection that may reach it from the cavum tympanum by so thin and delicate a bone partition as is the tegmen tympani. In the early development of the temporal bone, dehiscences and imperfections in the surface of this thin bone-plate are often found which are retained through life and it is very natural that infectious processes should thus rapidly find their way from the cavum tympanum through the tegmen tympani into the temporal fossa of the cranium. These very dehiscences and imperfections in the tegmen tympani are also frequently responsible for the rapid invasion of the cranial cavity following active suppurative processes in the ear in babes and young children, and for the rapidity with which meningeal symptoms are produced.

The tegmen antri is similar in structure to the tegmen tympani; a thin, weak and occasionally deficient lamina of bone which walls off the mastoid antrum from the deeper and posterior temporal fossa. It has been asserted by close observers that, with every active and destructive suppurative process that attacks the tympanic cavity proper, the mucous membrane lining the aditus, the antrum and the mastoid cells is also involved, and that exudates in the mastoid antrum occur with even greater frequency than is evidenced by our clinical and surgical data. If this observation can be substantiated, invasion from the mastoid antrum through its tegmen may threaten more frequently than has as yet been determined.

In the acute diseases of the middle-ear cavity which may lead to brain abscess, therefore, the two most vulnerable spots by which infectious matter may enter the brain tissue or its membranes directly are the tegmen tympani or tegmen antri, by erosions or through dehiscences.

Another avenue by which the cerebral fossa may be invaded and one which has been brought more prominently to notice in the last few years because of the distinct advances that have been made in its physiologic and pathologic study is the labyrinth. The pathology of the labyrinth was until recently a very obscure field in otology, but it is patent to every clinician and pathologist in this field to-day that a frequent source of invasion of the cerebral fossa is by an attack of a pathologic focus at the foot-plate of the stapes, the development of an acute labyrinthitis and extension of the process into the cochlea and either directly into the deeper cerebral fossa or by following the sheath of the auditory nerve to the cerebellar area.

There are occasional cases of invasion of the mastoid area, or even of septic foci in the cerebral fossa, which in their origin may defy most expert diagnostic skill and only be brought to light on the post-mortem table. These are the fortunately rare cases in which infection is carried to these deeper structures of the cranium either directly by the lymph-channels or by the blood-vessels in direct communication with the original focus of infection.

In passing, it might be only necessary to refer to the numerous emissary veins by which the lateral sinus may communicate with adjoining vessels; of bone perforations for the passage of nerve branches which may at times be the site of dehiscences where a purulent process may attack the vital areas under consideration from an unsuspected point; the facial canal, a tortuous bony aqueduct which may carry pus along the sheath of the nerve to the deeper structures and may infect the labyrinth and cerebellar fossa; all these are avenues of infection which must be taken in consideration when tracing a suppurative focus from its source.

Until recently abscess of the brain was regarded as a complication to be found almost exclusively in the chronic forms of suppurative otitis media, but as a vast amount of careful clinical observation and corroborative pathologic data are being accumulated we are beginning to realize that the acute and actively destructive pathogenic processes involving the middle-ear cavity are also agents in the production of brain abscess.

For many years we have been guided by the observation that a long-standing suppurative process in the middle-ear cavity with its natural destructive tendencies, bone erosions and necroses, cholesteatoma formations, sinus thrombosis, chronic mastoiditis, with its accompanying granulations and invasion through the tegmen antri of the posterior fossa — in fact, that all these more slowly developing pathologic processes were directly

responsible for the formation of extradural, subdural, cerebral or cerebellar abscess. But it is in the acute types that the more atypical development of brain abscess occurs.

The distinction which may be made between brain abscess developed as a sequel to an acute suppurative process in the middle ear and brain abscess developed as a sequel to a chronic suppurative process in the middle ear is, in my opinion, of as little significance from a pathologic point of view, as is the classification of acute, subacute and chronic otitis media suppurativa. The differentiation of the acute, subacute and chronic suppurative processes in the middle-ear cavity is largely a chronologic one and depends pathologically on the amount of tissue involved and destroyed and on the rapidity and virulence of the microorganism producing it. So, too, a brain abscess produced as a sequel to an acute suppurative focus in the middle ear, even if small in size, but dependent on an active streptococcic invasion, may be more serious and destructive and more frequently fatal in character than a brain abscess of large size produced by a less active staphylococcus where the abscess formation may have existed for months.

When we consider, therefore, irrespective of the fact that the invasion of the middle-ear cavity may be acute or chronic in character, that there is frequently an imperfect development of the tegmen tympani or tegmen antri; that the knee of the lateral sinus may encroach markedly on the posterior wall of the mastoid antrum; that the floor of the middle-ear cavity may be incomplete and imperfect and in close touch with the jugular bulb; that the petromastoid and petrosquamosal suture may remain unossified for many years; that emissary veins and small vascular and lymphatic vessels may be anomalously found throughout the depth of these areas, we are justified in our conclusion that there is an enormous possibility in both acute and chronic processes for extension of disease from its primal focus in the middle ear to its surrounding intracranial areas.

If it has been the consensus of opinion so far that brain abscess in its various types has been more frequently determined in chronic than in acute suppurations of the middle ear, is it not possible that the avenues of infection which are so numerous and often so anomalous have not as yet been perfectly understood?

The various types of brain abscess — (1) extradural abscess, (2) subdural abscess, (3) cerebral abscess, (4) cerebellar abscess — considered as sequelæ of middle-ear diseases are simply pathologic entities which differ in location, size and rapidity of development and are dependent on the intensity of the inflammatory process, virulence of the pathogenic organism producing it, resistance of the involved tissues and activity or chronicity of the original pathologic focal point.

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ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. M'KERNON, DERCUM AND GOLDSTEIN

Dr. John H. Gibbon, Philadelphia: Most of us who do much brain work feel, I think, that probably we are less certain in this field than in any other—and our mistakes come up before us when it is a question of localization of brain lesions. I remember twelve years ago a case in which a woman had middle-ear disease on both sides and all indications pointed to location of an abscess on one side; I made a complete exploration and found no abscess; the woman died and the lesion was found to be on the other side. Now that is an experience which a good many of us have had. It is a difficult point, too, and needs elucidation, whether the abscess is in the temporosphenoidal lobe or cerebellum. We have a better opportunity, I think, to say whether a tumor is located in one of these two positions than we have in the case of an abscess, and yet even in the question of tumor we are often mistaken. I recently made an exploration of the right hemisphere of a brain which another surgeon had previously examined, and neither of us found the tumor, though unquestionably the patient had one and at necropsy it was found to be in the cerebellum.

One point brought out in the paper by Dr. McKernon, which, of course, most operators appreciate now, and yet not all, is the mistake of exploration of the brain without reflection of the dura. One may feel a little safer without making a dural flap, but it is far better to have a large opening and make a dural flap. In the other method there is very apt to be an infection of the space between the brain and the dura and even when the flap is reflected the space should be thoroughly protected by gauze packing; I know of nothing more important than this. Of course, if the plan of Ballance is followed of doing the operation in two stages, this danger is largely obviated.

We have made the mistake too often of packing these cavities with dry gauze and medicated gauze, especially iodoform gauze. It is not the fault of the gauze but the way in which it is used. It is a mistake our dental friends make so often, that of packing a piece of cotton into an alveolar cavity. It acts as a dam. The tube, on the contrary, is hard and in the acute abscess cases is capable of doing damage. I consider the cigarette drain—not just a small piece of gauze—the best of all. It is not a cigarette drain until it has its covering of rubber or gutta percha tissue. Then we get capillary drainage, and that is the important matter, in organs like the pancreas and the brain. It should be put in gently and not packed tight.

Dr. George F. Cott, Buffalo, N. Y.: The first one hundred radical operations I did showed eighteen epidural abscesses from not one-half of which were there symptoms. In one patient, the only symptom of intracranial trouble was that he could not speak. On opening that patient's skull we found pus in the anterior fossa, covering the anterior half of the brain. Another patient came to the hospital and walked to the operating-table with no symptoms at all, not even pain or rise of temperature, and we found an abscess bathing the whole of one side of the brain, and at necropsy we found an enormous amount of pus. Both of these patients, however, were syphilitic.

Another patient, sitting in a chair when I was called to see him, had deep-seated pain, a temperature of 104, and had had chronic middle-ear suppuration for many years. In this case I expected to find epidural abscess. I operated and did find an epidural abscess, and pus in the lateral sinus. He apparently had no symptoms except the deep-seated pain. After operation he began to have typical temperature of phlebitis.

Another patient, a boy of 12, I saw in the afternoon and operated on the same day. He simply complained of not feeling able to be up; no other symptoms. He had chronic middle-ear suppuration. Radical operation was done and simply a thickened dura found. That night at 10 or 11 o'clock he suddenly stopped breathing and artificial respiration was carried on for about an hour, but the patient died. Necropsy showed a cerebellar abscess which had apparently no connection with the middle ear.

Another man complained of dizziness and had had chronic middle-ear suppuration for forty-eight years (he was then 49) and no other symptoms, except that occasionally he had attacks of vomiting. We examined the labyrinth and found total deafness and the labyrinth negative to the caloric and turning tests. Apparently the labyrinth had not been acutely involved. So we did a radical operation. The next day the patient said he felt well enough to get up and break stone. Two weeks later he was brought back complaining of giddiness again. There was no nystagmus and in a week he was sent home again. Five weeks later he came back again saying that he was suffering with dizziness and vomiting. He was brought in on a stretcher. We then found nystagmus to

the diseased side and we made a diagnosis of cerebellar abscess. We wanted to operate the next day but he died that night in a great deal of pain. At autopsy we found a cerebellar abscess without any direct connection with the old diseased bone, simply thickened dura.

DR. C. F. WELTY, San Francisco: The diagnosis of brain abscess has been materially improved and made easy within the last five years. I expected something from Dr. Dercum whereby we would be enabled to put our finger on the thing, say definitely here it is and we can operate in one case; let this alone, do not operate in another, but he does not give us anything of the kind. When I was *voluntär assistant* for almost two years in the University Ear Clinic at Vienna, we called in neurologists to assist us and we were more retarded by their advice than helped. Neumann says if you wait for the classical symptoms to develop the patient is beyond help. You must operate on the slightest suggestion; Dr. McKernon says "I have opened the brain several times, failed to find any abscess, but the patient recovered." If you delay in these cases they certainly go to fatal termination provided they have serious trouble. Dr. Dercum did not lay sufficient stress on localized pain. That is one of the very important findings, and must not be ignored. When you have the association of vertigo, vomiting and nystagmus, he says differentiation between cerebellar and cerebral abscess is hard to make. From a pathologic standpoint, the diagnosis can be made easily. Dr. Dercum is not familiar with the excellent work of Barany, which is world-wide and far-reaching. With his work before us it is possible to make the differentiation easily.

I had operated on a patient; two or three weeks afterward I received a message that the patient was paralyzed. The operation was on the left ear. Probably Dr. Dercum can help me out in this before I tell him what happened. She had not felt able to get up in the morning and at 6 in the evening she was paralyzed completely on the right side and had complete aphasia. The woman was a Russian and I could not talk to her. She was sent to the hospital at once and a neurologist was sent for. He diagnosed abscess in the middle lobe, which was my diagnosis also The patient was operated on the following morning. I put a knife in six different places and there was no pus anywhere. I put in drainage-tubes and closed the wound and the patient recovered. What was the lesion?

DR. S. MACCUEN SMITH, Philadelphia: A patient with multiple abscess of the brain was operated on for chronic suppurative otitis media, practically without symptoms other than otorrhea. During the operation we found a quantity of pus coming from the tegmen antri. Further exploration showed it escaping from the temporosphenoidal lobe, through a carious opening. The opening was enlarged which allowed the escape of an additional amount of pus. The patient progressed nicely for three weeks, at the end of which time she had convulsions, nystagmus and unconsciousness. She was taken to the operating-room and through the initial opening we introduced the knife anteriorly and evacuated pus from the frontal region. All went well for three weeks more, and then she had a repetition of the symptoms. The knife was introduced posteriorly through the same initial incision and pus was again evacuated from the occipital region. It will be noted, therefore, that pus was evacuated three times and the patient made a good recovery. I cite the case to suggest the adoption of the use of the knife, instead of probes or exploratory needle, or forceps.

I believe, with Dr. Dercum, that the previous history is a matter of much importance. Notwithstanding that there may be recurrent types, I believe, with him, that we frequently find that the abscesses in the chronic cases may have existed for a long time. I recall one case in which there were no symptoms referable to the ear for twelve years, but there had been recurrent attacks for fifteen or twenty years previously. I believe that in cases of suspected brain abscess formation, we are justified in looking for it in the temporosphenoidal lobe, because that is the usual site of involvement, and if the symptoms do not definitely indicate cerebellar involvement, we are justified in expecting to find it in the former place.

I do not think I ever saw a case of brain abscess in which the patient did not have persistent headache to some degree. Given a patient suffering with continued headache, accompanied by convulsive movements, with a history of previous ear disease, we should certainly suspect intracranial abscess formation. I lay little stress on absence of pressure symptoms. In a certain percentage of cases we do. not have symptoms of low pulse, temperature, etc.

DR. W. P. EAGLETON, Newark, N. J.: From several operations on temporosphenoidal lobe and cerebellar tumors, I am persuaded that the reason the diagnosis of brain abscess is so difficult is that the average otologist does not give the proper time to the neurologic examination of cases. Few of the symptoms of brain abscess now recognized are really taken account of by the otologist. I observed in the operations on the temporosphenoidal abscess a symptom, which as far as I know, has been very infrequently spoken of, and which I am persuaded is common; that is, a slight facial paralysis of the supranuclear type, on the side away from the lesion. It does not look like the paralysis from injury to the nerve; it is a slight wrinkling of the face on smiling. In examining my patients who have been operated on for mastoid disease and have not entirely recovered—who still complain of headache, or vomiting—I am surprised to find how frequently the so-called dreamy state is. I am persuaded that this condition shows an irritation of the dura over the temporosphenoidal lobe. Attacks of convulsions, as Dr. Dercum has said, any convulsion that occurs in an otologic case, should be thoroughly investigated. You should find out if preceding that convulsion there were any subjective sensations of taste or smell. Perversions of sight are very common in these cases. We should always examine, in a suspected case, the hearing on the opposite side. We will often find some perversion of hearing almost always in the early stage of abscess disease. The temporosphenoidal lobe should not be regarded as a "silent area." Of course, aphasia is common. The headache is always present. A great many of our mastoid cases go on for years with the same thing. The vestibular apparatus covers the whole field of the cerebellum. You must pay attention to the coordination of induced nystagmus. Many of the otologic cases with headache and running ear have this perversion of the pointing sense.

The Babinski sign is important following an attack of epilepsy. Recently lumbar puncture has been of importance to me in diagnosing between serous meningitis and abscess of the temporosphenoidal lobe. A child had convulsions of one side and both ears were running; I diagnosed an abscess. There was epigastric reflex present on one side, not on the other. There was spasticity of one leg. I did a lumbar puncture and withdrew fluid under tension. Immediately the symptoms of spasticity disappeared, showing that it was simply a form of edema. I opened both ears and did not go into the brain. The child died and it proved to be a serous meningitis. Many of the symptoms may be due to edema.

DR. C. R. C. BORDEN, Boston: I call attention to the examination of the opposite mastoid. I have had access to 452 autopsies in cases of diphtheria, scarlet fever and measles. In 202 cases the middle ear, mastoids or both were found to be involved. In the majority of cases the symptoms were not recognized during life and both middle-ear inflammation and mastoiditis were more commonly bilateral than unilateral. In fifty-nine mastoids which occurred in this series, only six were recognized and operated on. Thus it is perfectly possible to have acute mastoiditis present without apparent special diagnostic symptoms. The middle ear and mastoids were involved in 82 per cent. of the diphtheria cases, in 94 per cent. of the scarlet fever cases and in 100 per cent. of the measles cases.

I cite these statistics in order to emphasize the possibility of middle-ear and mastoid disease being active and present and still be unrecognized in spite of careful examination on the part of the attending physician. As we naturally expect to have mastoiditis as a primary cause of brain abscess, we must determine if possible the condition of both mastoid cavities; whenever the localizing symptoms of the brain

abscess are obscure. In the event of doubt as to the mastoid condition on one side or the other, I believe we are called on to open up the mastoid cavity, and examine it thoroughly, lest the focus of infection be located therein.

DR. LEE M. HURD, New York: Next to the otitic origin of brain abscess comes that of the accessory nasal sinuses. Middle-ear disease in a considerable number of cases is due to these accessory sinus infections and the same is true of abscess of the frontal lobe. Stucky has reported a number; so has Coffin, and I have reported a few. But it is difficult to differentiate the frontal lobe abscesses from those of the temporosphenoidal lobe. The nasal accessory sinuses should always be examined carefully in these cases.

DR. G. W. MCKENZIE, Philadelphia: No disease has such various symptoms as cerebral or cerebellar abscess. Brain abscess passes through four stages: initial, latent (which may be prolonged), manifest stage and terminal stage. Cerebral abscess of otitic origin is often accompanied by other complications, epidural abscess, sinus thrombosis or meningitis. We may, therefore, have symptoms not due to the abscess itself, but to the products of the pus-symptoms from pressure, where the abscess is large. Then, symptoms of the opposite side may be caused by pressure on the medulla at the foramen magnum. Of course, later we generally get meningitis. One of the most important works written on this subject is that of Neumann (1908), in which he pointed out the differential value of nystagmus and equilibrium disturbances. When a patient has had, for instance, a previous abscess of the inner ear with symptoms of nystagmus to the well side, combined with other symptoms, such as headache, and develops nystagmus to the diseased side, it is almost proof positive of the cerebellar abscess.

I have studied several cases in which the great variability of the nystagmus struck me. On the same day the patient had had nystagmus at one time to the well side, and at another to the diseased side. Another important sign is that the nystagmus of the internal ear is generally rotatory, while that of the cerebellum is more apt to be horizontal. Localized tenderness is a valuable sign, but it is not to be associated with epidural abscess. Headache may be very variable. I have frequently found frontal headache with cerebellar abscess.

DR. E. L. BULL, Jersey City: A man, aged 30, sent to me by his family physician who had treated him for a long time for very severe headaches on the right side, had had a running ear since childhood. The headaches were very severe and localized in the temporal region, on the right side to a point that the patient said he could cover with the end of his thumb. This case was observed for two weeks, when the patient came to the office insisting that something be done, as he could not stand the pain. He was sent to the sanatorium and prepared for an intracranial operation, but when a radical was done and the tegmen antri and tegmen tympani found normal, the operation was stopped. The patient made a perfect recovery and the headaches entirely disappeared. He had at the same time complained of asthenopia, which also disappeared after the operation.

A child of 5 years was brought into St. Frances Hospital, Jersey City, by its mother for what she thought was a boil back of its ear. An intern opened the abscess, and in a few days, as it continued to discharge, he asked me to see the case. On passing a probe into the incision made back of the ear, dead bone was encountered and the probe passed into a cavity of considerable size. We then learned that three months previously the child had had measles and had had a running ear since that time. There was no history of earache and the child had had no pain since entering the hospital. I thought the trouble a simple mastoiditis. On operation complete destruction of the mastoid was found; the floor of Troutmann's triangle was completely destroyed, and the posterior canal wall was picked out as a sequestrum; Nature had done a complete radical mastoid operation. On removal of the overhang posteriorly in the region of the sinus a large extradural abscess was opened.

The cavity was packed and drained and the child made an uneventful recovery.

DR. ANDREW TIMBERMAN, Columbus, Ohio: Schwartze once said to me, what he afterward said in his most admirable work, "Die chirurgischen Krankheiten des Mittelohrs," that all the symptoms of an abscess might be present and yet no abscess be there—that there might be no symptoms of an abscess, and the abscess still be there. After that dictum I have felt rather easy when I have found that I had made a mistake, especially when I had called a neurologist in consultation. When I heard Dr. Welty say that the diagnosis was very easy I thought a new light was coming into the otologic world, but he spoiled the whole thing by reciting his last case. One of my troubles is this: a case of chronic otorrhea, probably due to measles or some other infectious disease, with discharging ear—practically nothing else. Under treatment its progress is arrested, but not cured. A sinus may lead into some portion of the middle ear. In spite of a few weeks' or even a few months' treatment, the sinus persists. The patient wants to get rid of the discharging ear and we decide that the only thing to do is a radical mastoid operation. We do it. The operation goes nicely; the patient apparently gets better, and then suddenly develops that persistent lancinating pain which he describes as making him feel as if his head would burst. There is a slow pulse—a pulse that Schwartze calls relatively slow. A patient with a fever of 101 ought to have a pulse faster than 72 or 80; if he has no fever, he should have a faster pulse than 50 or 60. With the development of these symptoms and others, we diagnose brain abscess which sometimes we find and sometimes we do not find, but my trouble is this: Was the brain abscess there before I operated or is it there as the result of my mastoid operation? I had one case in which I persisted in the diagnosis of brain abscess when the surgeon and neurologist were against me. I stuck to it because of the blood count; not a high leukocytosis, but a low one, and I had the temerity to say that it was a chronic abscess. The necropsy revealed an encapsulated abscess.

DR. HERMAN JARECKY, New York: An emergency case was referred to me at the Sydenham Hospital, in which the young man was in a condition of collapse. He had had headaches for a few weeks. Two days previously he had gone to the dispensary and had had one ear opened and drained, but the headache persisted and he had vomiting spells and slight fever with relatively slow pulse and then complete collapse. The pupils were unequal. I decided that it was a brain abscess and operated immediately. I did a radical operation and found nothing in the mastoid. I opened up the space above and there was nothing wrong with the dura. The only place where pus was found was in the zygomatic arch. I did not interfere with the dura at all. In two days the inequality of the pupils disappeared, pulse became normal, dizziness disappeared, and in three days the patient could sit up and in a week was out of bed. He made a rapid and complete recovery. He had the classical symptoms of brain abscess, and yet pus was found only in the zygomatic arch.

We have not yet reached the point where we can say with absolute certainty that a patient has abscess of the brain or not. Opening the dura would not have helped me in this case at all. Some years ago I saw an old chronic ear case in one of our public hospitals with symptoms among others of marked dizziness, staggering gait and falling backward; diagnosis of abscess was made. The general surgeon operated and did not find an abscess. Autopsy, however, disclosed an abscess. The symptoms are certainly very varying, and each case must be studied on its own merit and we must have every aid, including that of the neurologist, to help us in making a diagnosis.

DR. W. A. POTTER, Detroit: It has been proved by men in the Vienna school that the majority of cerebellar abscesses are complicated by labyrinthitis, acute or chronic. To differentiate cerebellar from temporosphenoidal lobe abscess, if we test out the labyrinth and find no nystagmus on caloric and none on turning and no fistula, our attention is immediately directed to the cerebellum, but if the labyrinth is active our attention is immediately turned to the temporosphenoidal lobe. Following the cases from this standpoint, if we do not find what we are looking for at the operation we are not in disgrace.

DR. J. A. STUCKY, Lexington, Ky.: It is not sufficient just to make an occasional differential blood-count. We all know

that often the diagnosis of intracranial complication is made by exclusion. We have the psychic symptoms, with peculiar headache and the modified slow pulse, etc., and still we are not sure as to whether we are justified in doing an exploratory operation and here is where the differential blood count made daily or twice a day will help us in reaching a decision. On three occasions I have opened the temporosphenoidal lobe and found pus on only the laboratory findings. The leukocytosis had suddenly decreased and the polynuclears increased. We do not place too much importance on a high leukocytosis, but when that begins to decrease and the polynuclears to increase we know our patient is absorbing rapidly and after excluding everything else we are justified in doing an exploratory operation. I have discarded gauze entirely in drainage. Ballance taught me several years ago that two or three small drainage tubes were far better than one and I still believe that is so. Two or three cigarette drains are better than the small rubber tubing. And since I have been using the cigarette drain I have not had hernia complications.

We must always have atypical cases. Three weeks ago I operated on a young man with no symptom except discharging ear and slight pain in the head. I found in exploring the temporosphenoidal lobe an abscess the size of a pigeon egg. A week later there was return of the headache and the patient went down rapidly. Autopsy showed complete degeneration of one-half of the brain although there were no focalizing symptoms.

DR. M. M. CULLOM, Nashville, Tenn.: We have all encountered the type of a mastoid which perdisposes to intracranial complications—a mastoid with a small, deeply placed antrum, covered with bone of exceeding density. The bone is of ivory-like hardness with a complete absence of pneumatic spaces. I have always been taught that this condition of the bone was the result of disease, an eburnation of the bone, a rarefying osteitis the result of chronic suppuration. To my mind Mr. Arthur Cheatle of London has upset all our theories and rewritten pathology on this point. In his magnificent collection of sectioned temporal bones numbering somewhere near a thousand he has shown that 20 per cent. of all normal mastoids are of this type.

He has named this type of mastoid the infantile type. It has all the characteristics of the infantile mastoid except that the outer antrum wall is greatly increased in thickness and density. Now what is the practical point? It is that infection in such a mastoid may be attended with an utter absence of external physical signs. Tenderness cannot be elicited on account of the density of the wall. Likewise redness and swelling are absent for the same reason, so that necrosis may proceed unperceived by the surgeon. On account of the density of the bone it is unable to extend outward or downward and more readily extends to the middle or posterior fossa.

DR. THOMAS HUBBARD, Toledo, Ohio: The relation of accessory sinus diseases and ozena to mastoiditis and brain abscess is a point that has not been referred to. As otologists we rather neglect routine examination of the nasal fossæ in mastoid cases, and especially such examination as would be useful in the study of complications of mastoiditis, such as brain abscess. We rarely find in the general reports of mastoid surgery and its complications reference to special examinations of the nose. Nasal suppuration considered simply as a cause of mastoiditis is of sufficient importance to merit routine study; and occasionally it may be the direct cause of brain abscess, and the mastoid disease a side issue. This subject was brought to my attention in the case of a woman who was in the hospital a few days for acute middle-ear disease, right side, with symptoms of mastoiditis and who escaped from the hospital and disappeared. Her unruly conduct at this time was probably due to cerebral disease. She came to my office ten days later and immediately on examination I realized that she was in a very serious condition. She had several symptoms of brain abscess; slow pulse, sluggish mentality, severe headache (right occiput), and the history pointed to the mastoid as the cause. I learned that only that morning while sitting with her baby in her lap she had indifferently allowed it to slip to the floor and without heeding the cries of the infant sat dazed and stupefied. I advised her to go to the hospital expecting to operate and find temporosphenoidal abscess due to the mastoid suppuration. The attendant who came with her remarked to me that she had long been fearful that the woman would injure herself as she had often noticed her picking scabs from her nose with a piece of wire. I found that she had an extensive ozena, and considerable areas of excoriated mucosa with granulations were visible in the upper fossa. I didn't hear from her that afternoon and called the next morning. She had died during the night. Autopsy revealed the mastoid cells filled with granulations and pus, but no abscess in the middle, posterior lobes or cerebellum. In the right frontal lobe, however, in close proximity to the cribriform plate there was an abscess three-quarters of an inch in its long diameter—evidently a rather old one as it had a firm wall, and there was an old fistulous lead toward the cribriform plate. In this case it is probable that the source of the brain infection was the nasal fossa and the mastoiditis was incidental. I examined the ethmoidal and sphenoidal sinuses and there was no evidence of chronic suppuration.

DR. W. L. BALLENGER, Chicago: It has been my misfortune to see a number of cases of brain abscess. I say misfortune because in many of the cases I have failed to afford relief. A few years ago we diagnosed an abscess of the brain located in the arm and leg region. We operated and drained the abscess, but the patient died in forty-eight hours. This winter I saw a case of abscess diagnosed by a leading neurologist and myself. There was paralysis of the arm and leg of the opposite side. There were also, in the early history of the case, some very interesting points. The patient had a peculiar gait, followed by complete paralysis of the left leg and left arm. In the early stage of the trouble there was history of difficulty in swallowing and the existence of hoarseness. The neurologist thought the case probably one of abscess of the cerebellum at the pontine angle on account of the involvement of the larynx. There was no nystagmus of any kind. The physician in charge of the case was an intelligent specialist who said there was no nystagmus at any time. This made me doubt the diagnosis of the location. We did not find pus on exploration. Before the patient went home she had gained to a large measure the use of the arm and leg. The patient is still living and is improving somewhat as to the paresis.

I had this winter an interesting series of cases, eight or ten, of mastoiditis, all of which followed acute tonsillitis. There was subsidence of the tonsillitis and then development of mastoiditis and then intracranial complications. These were all in private practice. The series included brain abscess, lateral sinus thrombosis, meningitis, circumscribed meningitis and leptomeningitis. In none of the cases of abscess so diagnosed were we able to drain the abscess. I consulted a neurologist who thought one case to be temporosphenoidal abscess. We explored this lobe and then went through the tentorium but did not locate an abscess. I made a lumbar puncture and found the fluid loaded with pus. The patient died in forty-eight hours of meningitis.

As to the value of the nystagmus as diagnostic between cerebellar disease and labyrinthine disease: the nystagmus of cerebellar disease is usually of increasing intensity, whereas in acute destruction of the labyrinth it diminishes in intensity and ceases in a few days. That is a point that may aid us sometimes. And so the pointing test of Barany is of immense value.

DR. C. M. MILLER, Richmond, Va.: I had a few years ago what was to me something new. I was called in consultation to see a young man who had distinct mastoiditis, very acute, not chronic, bulging drum, etc. I made a free incision, and insisted on immediate mastoid operation. The patient was timid and refused surgical aid. His physician, who was a relative, persuaded me to continue in the case and treat it. Finally the patient was able to go around and at the end of ten days, though there was still tenderness, sagging of the posterior wall, etc., he was able to go to his office and attend to business, but after a few days he decided to go to the hospital for operation. We had made an exhaustive history

of the case. He thought he remembered in childhood having had a running ear for a short time. We opened the mastoid and cleaned it out but did not lay bare the dura at any point; on uncovering the lateral sinus it was found to be healthy. Early in the morning of the eighth day after operation I received a hurry call saying that the patient was suddenly stricken unconscious with stertorous breathing and slow pulse. I told them to put him on the table and have him ready for operation. I removed a large part of the squamous plate and found the dura as hard as the skin over the bone. I made a crucial incision 1½ inches in each direction and there was voluntarily extruded an encapsulated abscess 2 inches in its greatest diameter and over 1 inch in its smallest, oval in shape; at the point nearest the petrous portion there was a necrotic spot a half inch in diameter. The pathologist made a diagnosis of encapsulated abscess not less than six months old. Now there was no history except this vague one of running ear during childhood; no symptomatology during this attack except that the patient complained of occasional photophobia; fundus oculi was not examined. He died in twelve hours with temperature rising to 106.5.

DR. MAX GOLDSTEIN, St. Louis: In this discussion all opinions seem to point to the indefiniteness of diagnosis. All seem to agree as to surgical points, technic, etc., but the great stumbling-block is diagnosis. Almost all of the cases that have been specially mentioned have been atypical cases. It seems that nearly all the cases of brain abscess are atypical. I do not think the difficulty of diagnosis obtains in apparently typical brain abscess. Until we can arrive, from further data, at a more substantial conclusion as to what constitutes a real symptom-complex in brain abscess, we will continue to have difficulty in reaching a standard by which we can agree as to when to operate and when to wait, or how to differentiate the various types. Too little stress has been laid on the question of destruction of the labyrinth. The labyrinthine research of the last five years, of Barany, Neumann, Alexander and others has been so excellent and active that much valuable information has been obtained, and the diagnosis of labyrinthine diseases and their relations to intracranial complications may now be determined with considerable less difficulty.

DR. JAMES F. MCKERNON, New York: In Dr. Goldstein's paper he mentions that one of the causes of intracranial complications is the dehiscences in the bone. Eight years ago I presented a communication to the American Otological Society on primary bulb thrombosis in children and called attention to the fact that one of the pathways of infection was the presence of these dehiscences in the floor of the middle ear. During the past year and a half I have been making investigations to substantiate that theory. We have had 166 autopsies and in that series there were dehiscences in 28 per cent., leading from the floor into the jugular bulb. It is not probable that they all remain there during life, but it is possible that some of them do and that that is the pathway of infection in these cases. I thank Dr. Gibbon for bringing to my mind one point, and that is protection of the dura at the time of incision. We do protect it, not only with gauze, but cover that with rubber tissue.

DR. F. X. DERCUM, Philadelphia: I recognize fully the importance of determining the labyrinthine condition, but that, of course, is the business of the otologist and not of the neurologist. With regard to the diagnosis of brain abscess, the use of brain puncture, as practiced by Foerster, Pfeifer and others, might now and then in brain tumor prove of value, but it is a dangerous proceeding in brain abscess because it may lead to increased spread of the mischief.

The symptomatology is very different from brain tumor. In brain tumor the diagnosis is very much more clear and definite. We can make out the localization of the growth in many cases, but we frequently fail when the question of brain abscess comes before us. Otologists see, of course, more cases of brain abscess than the neurologists. The latter see them generally when called in by the otologist or general practitioner.

With regard to diagnosis, it seems to me we should perhaps study the nature of the disintegrating process in the brain, its chemistry, etc. We know that the pus of brain abscess is peculiar in several respects. We know the patient has a condition of mental confusion which is not caused by pressure, but doubtless is due to some toxic agent that is being secreted. Another symptom is that peculiar fetor of the breath with which we are all familiar and which probably also has to do with this toxic agent. This is not present in brain tumor or thrombosis. We must look to our chemists to give us some additional information for we need something more definite on this subject.

THE RELATION OF NASAL CONDITIONS TO ASTHMA

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Asthma is a condition or symptom-complex characterized by intermittent paroxysmal dyspnea and vasosecretory disturbances. As yet, so little is positively known of its etiology and pathology that great differences of opinion exist as regards an exact definition of the affection.

So-called cardiac and renal asthma are not considered in this discussion, since they are not true asthma but rather dyspnea, and are clearly distinguishable from asthma proper.

The principal pathologic conditions exhibited by an attack are spasm of the bronchial and other respiratory muscles, especially the diaphragm, and turgescence, edema and hypersecretion of the mucous membranes of the respiratory tract, resulting in extreme emphysema of the alveoli.

Of the 200 cases diagnosed as "asthma" at St. Mary's Hospital (Mayo Clinic) during the past three years, in sixteen there were lesions of the heart, lungs or kidney sufficient to give symptoms overshadowing those from all other sources. Some of the patients also had pathologic conditions in the upper respiratory tract of secondary importance, which may have contributed to the symptoms.

In 184 of the series the principal lesions were found in the nose, in the accessory nasal sinuses or in the nasopharynx. One hundred and fifty-seven of these had evident purulent, mucopurulent or seropurulent discharge in the nostrils or in the nasopharynx.

Fifty-eight had polypi in one or both nostrils, fifty-two had polypoid degeneration of the mucous membranes of the middle turbinals, and one of the ethmoid region.

Sixty-three patients had suppuration of one or both antra, and in nineteen antra which produced no pus on irrigation were dark on transillumination. In some of these cases there was undoubtedly an inflammatory condition of the antrum without the accumulation of pus.

Twelve children, from 11 months to 11 years of age, had large tonsils and adenoids, associated with, and probably in most cases the cause of, chronic edematous rhinitis.

One hundred and thirty-eight of the 200 patients under observation have been treated by operation, local applications in the nostrils or by irrigation of the accessory sinuses.

Reports from 104 patients, treated more than six months ago, have been received and tabulated as to results, without regard to the extent to which the treatment had been carried. In several instances, only a single treatment had been given, or, an operation had been performed and its object not assured for want of

after-care. Other patients who were free from symptoms for from six months to one year had suffered recurrences and are here classed according to their present condition. Most of these patients are non-residents and many are in such circumstances that they are unable to remain or to return for satisfactory treatment.

Although the tabulation does not show it accurately, a study of each individual history indicates that, almost invariably, relief of the asthmatic symptoms corresponds in degree to the extent to which the pathologic conditions in the nostrils, nasal sinuses and nasopharynx have been improved. This response of the more general symptoms of asthma to strictly local treatment in the upper respiratory tract confirms the opinion which the constant association of lesion in that region with asthma has given, viz., that these lesions are the cause of abnormal systemic condition and that asthma is the manifestation of that condition.

Since the publication of the results of experiments in anaphylaxis by Theobald Smith, Otto,[1] Rosenau and Anderson[2] and others, the theory that in anaphylaxis is to be found the explanation of the occurrence of asthma has been advanced by Meltzer[3] and others. Auer and Lewis[4] have demonstrated conclusively that the dyspnea which is the chief manifestation of anaphylactic shock is produced by stenosis of the bronchioles, by spasm of the circular bronchial muscles, and that, while this stenosis is associated with, it is not dependent on, spasm of the diaphragm, since it can be produced separately. This muscular spasm and the resulting emphysema can be produced in the absence of the central nervous system, thus proving that it is not a reflex but a local reaction to systemic condition.

RESULTS, AFTER SIX MONTHS, OF THE TREATMENT OF 104 PATIENTS

	Entirely Relieved	Markedly Improved	Slightly Improved	Not Improved	Total Number
Local applications or irrigations of the accessory sinuses	8	11	3	4	26
Operations on polypi, middle turbinals or ethmoid	11	11	13	15	50
Operations on the antra, one or both	5	5	1	0	11
Operations on antra and middle turbinals and ethmoid	2	4	2	1	9
Operations on inferior turbinals or septum	0	1	0	1	2
Operations on tonsils and adenoids	5	0	0	1	6
Totals	31	32	19	22	104

Exactly the same condition of the lungs exists during a paroxysm of bronchial asthma, and thus it is reasonable to assume that in asthma also the reaction is due to the effect of a general condition on the muscles or nerve-endings of the bronchioles, and that a reflex neurosis is of a secondary importance and not essential to the production of the symptoms of asthma.

It has been proved experimentally for hay-fever and the asthma that accompanies it that, on the introduction of a minute quantity of the toxalbumin of the pollen into the blood of an individual subject to those affections, the symptoms of hay-fever and asthma appear, while in the normal individual no reaction occurs. The same has been found to be true of the emanations of animals in the cases of those sensitive to them. The sensitization has undoubtedly taken place by previous entrance of a foreign proteid into the blood or by heredity, which is an active factor in both asthma and anaphylaxis.

More numerous and more serious are the cases which require the presence of no external irritant to produce the symptoms of asthma, but in which also the symptoms are exactly similar to the anaphylactic reaction. So it is reasonable to assume that in the cases considered as idiopathic asthma there occurs the entrance of a foreign proteid into the blood in some way not yet demonstrated.

It has been found that a foreign proteid capable of sensitizing the individual and later of producing the anaphylactic shock may result from autolysis of retained placenta or other tissues. The frequency with which retained and altered mucoid and purulent discharges are found in the nostrils or nasal sinuses suggests that here is the site of the production and entrance into the blood of the foreign proteid which produces the anaphylactic reaction in these cases. The quantity of the foreign proteid necessary to sensitize and later to produce the anaphylactic reaction in a susceptible individual is so small that the known absorptive powers of the nasal mucous membrane could undoubtedly pass it into the blood under suitable conditions. Moreover, the reaction has been produced experimentally in guinea-pigs by the inhalation of animal emanations followed by the injection of serum from animals of the same species.

The results of treatment of nasal conditions in asthmatic patients present still other analogies to anaphylaxis. Operation to establish free drainage and aeration of the mucous membrane of the nose and accessory sinuses prevents retention of secretions, while in other cases the same may be accomplished by local treatment to stimulate profuse discharge so that secretions are washed away before autolysis occurs. This prevents the formation and intermittent absorption of the specific foreign proteid which causes the anaphylactic reaction, commonly known clinically as asthma.

So long as secretion and drainage are free and continuous, relief from asthma will be complete, but recurrence will usually result from the interruption of drainage even after long periods of immunity from symptoms.

1. Otto: Handbuch der path. Mikroorganismen, 1908, ii, 255.
2. Rosenau and Anderson: Arch. Int. Med., 1909, iii, 518.
3. Meltzer: THE JOURNAL A. M. A., Sept. 17, 1910, p. 1021.
4. Auer and Lewis: Jour. Exper. Med., 1910, xii, 151.

FURTHER EXPERIENCE WITH ENDOBRONCHIAL THERAPY OF ASTHMA

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In the cure of bronchial asthma a great many factors have to be eliminated before we decide to resort to endobronchial treatment. The first to consider is the psychic element, which is manifested so strikingly in all those cases that can be influenced beneficially by suggestive therapy. It is these which furnish the wonderful results that are triumphantly recorded by ignoramuses and charlatans. But the large majority of cases demand every resource of medical science which too often is only very difficult to bestow.

In a previous communication, I gave a brief historical review of the excellent showing made by laryngologists in the cure of asthma. Names like Voltolini, B. Fraenkel, Hack, Bosworth and others will bring back to memory some phases of what has been accomplished in the past. They and many others have demonstrated that asthmogenous points may be found in the nose and throat (nasal polypi, spurs, adenoids, etc.), and that by removing the existing pathologic conditions, we may and do rid a number of asthmatics of their trouble. These

are established historic facts which cannot be disputed. But many other chronic diseases may reflexly lead to asthma. Thus, Carl von Noorden but recently drew attention to the frequency with which asthma is associated with eczema, although the same observation had been made long before. Furthermore, affections of the uterus and its adnexa or of the stomach and lower digestive tract may prevent the cure of an asthmatic patient, no matter how successful treatment has been otherwise.

If in spite of every precaution, i. e., a thorough examination of all these organs followed by treatment of any existing disease, the patient is still suffering from asthma, the physician is not only entitled, but morally bound, to put him or her to some more inconvenience. i. e., directly to inspect the bronchi, which, after all, are the real seat of the disease. In doing this one will note that the so-called asthmogenous points are to be found here as well. Many pathologic conditions will be disclosed, and it will be, as it was in the beginning of the laryngologic era, when, for example, a case of hoarseness was not only treated with ammonia and blood-letting, but was really "demonstrated *ad oculos*." It will repay the practitioner scientifically to do bronchoscopy, for it is most interesting work. Thus far, however, some physicians are opposed to this procedure in cases of bronchial asthma. They know the difficulties and dangers of bronchoscopy in cases of foreign bodies, but have not learned of its use for other purposes. In the many cases in which I have used this method under local anesthesia I have not seen the least danger result from it. Besides, with a little good will and cooperation on the part of the patient, it is not even painful. It is in such diseases as asthma, however, that we have a great variety of patients to deal with. Thus, if a badly behaving person coughs into your face even on examination of the pharynx, you will not be able to resort to bronchoscopy at once. On the other hand, I have done bronchoscopy on hysterical patients without any anesthetic whatsoever. These are extremes which encompass all shades and varieties. As a rule, however, I do bronchoscopy in my office and the patients can go home at once. The physician has to exercise a great deal of tact to gain the confidence and cooperation of the patients or else they will not respond and be helpful to him, and he will surely not benefit them.

Now, what pictures do we see endobronchially? Does this method confirm our former knowledge of the morbid anatomy of the disease? Asthma being to a great extent a functional affection, no gross lesions were formerly found while other signs were perceptible mostly *intra vitam*. In pronounced cases, bronchitis is almost invariably associated with the asthma. Endoscopically, therefore, the mucous membrane will be found more or less swollen, often to such a degree that the cartilaginous rings cannot be seen at all. This swelling is sometimes so pronounced that it bulges into the lumen of the tube and for a moment one may be in doubt whether one is in the trachea (bronchi) or esophagus.

As the carina (bifurcation) is but little marked in such cases, it may happen that one passes the bifurcation without being aware of it. In the smaller bronchi this condition is even more pronounced, so much so that occasionally—as has been pointed out before—the orifice of a smaller bronchus does not appear larger than the head of a small pin. In such a case, the diameter of the bronchus may not show any difference during inspiration and expiration. Von Schroetter observed even the reverse of the normal condition, i. e., during inspiration the swollen mucosa was sucked in and the lumen of the bronchus thus closed, all owing to decreased inspiratory pressure.

The rhythmic contractions of the trachea and bronchial ramifications are at times seen very plainly, but again may be hardly noticeable. The same holds good of the respiratory excursions of the bronchial tree. In no case of asthma have I ever seen the bifurcation move forward and downward, as it does normally.

Spasmodic contractions of the bronchial muscles are quite frequently noticeable, but generally they can be overcome by the application of cocain. This contraction is observed even when the patient is breathing quite comfortably, but in such a case only a smaller bronchus is affected. On endobronchial inspection, furthermore, all kinds of catarrhal conditions will be found, represented in bronchitis, from a very slight injection of one small bronchus to a swelling of the entire mucous membrane. It seems to me that the latter is to be found especially beyond the place where the spastic contraction takes place. Thus, we will often observe a capillary bronchitis which is not only due to an inflammatory process, but also to nervous disturbances.

I would emphasize that on inspection of the bronchi, the same conditions will be encountered as in the larynx; one portion is affected, the other not. One bronchus may be seen highly congested and thickened, while the other, right next to it, may have a normal appearance. The belief that in asthma the process must necessarily be disseminated all over the bronchi is erroneous. Occasionally you will also find an ulceration, but that is rather exceptional.

TREATMENT

In a previous paper, I asserted that the introduction of the bronchoscopic tube is in itself of therapeutic value, as it relieves the patient of a great deal of secretion, thus naturally rendering breathing easier. But with clearance of the air-passage the task is not accomplished; there remains, as Berkart[1] calls it, the source of the disease. Now we can reach the mucosa directly and make topical applications. At the beginning of my experiments in this direction I used to limit myself at this stage chiefly to the injection of adrenalin (epinephrin), of which large doses were used. But having since then recognized the great danger of this drug in some instances, I now employ much smaller quantities, viz., 15 to 20 drops of a 1:5000 solution. In addition, many of our old well-established astringents have been applied; for example, nitrate of silver, chlorid of zinc, argyrol, sulphocarbolate of zinc and others. In cases in which the secretion has ceased after repeated introduction of the tube, the insufflation of anesthesin or orthoform has had a very sedative effect.

It is not sufficient, however, to depend solely on local applications, for in asthma, more than in other systemic diseases, the specialist must never forget that he has to treat not a single organ but the entire system. The stomach and bowels have to be regulated, an appropriate diet should be prescribed for each individual case, the amount of work and rest must be determined, etc. By all means, the patient must be shown that you are master of the situation, that he must do what you want him to, and that he is capable of accomplishing it. If he learns to obey you, he will carry out your suggestions and will get well.

After the patient has received a thorough course of endobronchial treatment, there is nothing that will assist

1. Berkart: Bronchial Asthma, 1911.

so much in building him up and completely eliminating the disease as a change of climate. There are many resorts here or abroad that are well adapted for such cases, but the selection of the most suitable is not always easy. It will depend on the physical and mental state of the patient, and on the nature of the complications, anemia, obesity, weakness of the heart, derangements of the digestive organs, diseases of the skin, etc. Each of these affords a different indication. "Thus in the one case alkaline muriatic, in another alkaline saline, in another ferruginous, in still others sulphur or arsenical waters[2]" will give the best satisfaction.

RESULTS

To effect a cure in cases in which all former methods have failed — and of these there are not a few — we welcome any new procedure, however difficult its use. The endobronchial treatment, according to the reports of those who have earnestly tried it, fulfils all we expected of it, and will, I am sure, give even better results in the future. After a somewhat extended experience, I feel inclined to say that more than 50 per cent. of patients treated endobronchially have been cured, and that is conservatively speaking. It must be understood that all these cases had been previously submitted to all other means at our disposal and that topical applications to the bronchial mucosa had been the last resource. Where we succeed in finding the asthmogenous points in the bronchi and are able to treat them directly, we generally get quick results. Where we are unsuccessful in that respect, the treatment is prolonged and the outcome doubtful. Furthermore, if neurasthenia is the dominant feature and asthma only one of the many other symptoms of the underlying disease, our task will likewise be very difficult (Case 4).

A relapse may occur after a year or sooner, but such cases generally yield quickly to treatment. Sometimes one or two local applications suffice to restore the lost equilibrium. But I have had cases in which complete relief from the asthmatic attacks has lasted over two years, i. e., ever since I first began treating asthma endobronchially. I may justly assume that such patients are permanently cured.

During the past year I have treated a number of cases of which I will mention only a few instances.

CASE 1.—Mrs. S. H., aged 48, has suffered from asthma for the last twelve years. Several members of her family had the same disease. She had consulted many physicians here and abroad and had taken cures in Germany, England, Switzerland and Egypt. An area between her shoulder-blades was very sensitive, so sensitive that the bare idea that some one might touch that spot gave her pain. She could not sleep longer than two hours at a stretch and smoked many cigarettes (stramonium). She had five intranasal operations and presented a rhinitis sicca. Treatment was begun September 30. As she absolutely refused to permit any application to her nose, I started at once with bronchoscopy. Half an hour after a hypodermic injection of morphin (¼ grain) the tube was introduced. I did not pass it very deeply at this attempt, hardly reaching the bifurcation, but the patient was convinced that the introduction of the tube was possible and that without much inconvenience to her. By and by the morphin was discarded and only local anesthesia relied on, with the result that I finally could easily explore any part of the bronchial tract. The right side was almost exclusively affected and topical applications of silver nitrate (3 to 10 per cent.) cured this patient in about ten weeks.

CASE 2.—H. L., bookkeeper, aged 36, a nervous wreck, had suffered with asthma for twenty-five years. Endocarditis was present with anasarca for one year. I had to give him ⅓ grain morphin besides the use of local anesthesia before bronchoscopy could be done. After several weeks he felt greatly relieved, but the morphin caused a good deal of obstipation, a condition from which he had suffered anyway for years. He had pronounced hemorrhoids, but refused to have them removed. The indication for such an operation was very urgent, as his bowels and stomach were constantly upset. This finally prevented a cure of his asthma and he had to be discharged.

Comment.—This case shows distinctly, as pointed out above, that an asthmatic patient can never be cured unless all abnormal underlying conditions are removed. It is my conviction that this man could have been cured by endobronchial treatment if the hemorrhoids had been removed and his diet regulated.

CASE 3.—Miss R. G., aged 25, had suffered with asthma for the past five or six years. The patient was very stout, had poor appetite, and her attacks occurred in the daytime as well as during the night. Aside from the topical applications of diluted adrenalin (epinephrin) and chlorid of zinc to the bronchus which seemed to be mainly affected, she resorted to gymnastic exercises, etc., and within five weeks felt perfectly well.

CASE 4.—Annie ——, 28 years old, is the severest sufferer from asthma at the Montefiore Home; in fact she hardly gets over one attack when another follows. I saw her on January 10, when she was struggling for breath, applied a 5 per cent. cocain solution and inserted the outer tube only. The pulse had been so weak that I did not risk pushing the cocain. After removing the tube her breathing, if anything, was worse. Then I told my assistant in a loud voice to give her a hypodermic of morphin, "the strongest we have." He understood and injected some distilled water, whereupon the patient breathed naturally within three minutes.

Comment.—This is a case of such pronounced neurasthenia that asthma is only a small portion of the patient's trouble. Her attacks are certainly very severe. She was cyanotic when I saw her, but all symptoms disappeared after she received the supposed morphin injection. I found out later that she was accustomed to bring on these attacks especially when many physicians are around.

CASE 5.—M. N., aged 43, banker, had been suffering from bronchial asthma severely for one year and was forced to give up his business. He had consulted several laryngologists and internists of this city and had received intranasal treatment. On introducing the tube into the left bronchus, such a remarkable pulsation was noticed that I was almost certain I had to deal with an aneurysm of the aorta. The tube was withdrawn and the chest reexamined for an aneurysm, but with negative result. Nor did a skiagram show any evidence of such a condition. Finally, I concluded that this phenomenon was nothing but the pulsation of the normal aorta that was closely attached to the left bronchus. These pulsations were transmitted even to the tube and could be seen externally.

Although this point has been brought to notice before by H. von Schroetter,[3] I was still under the impression that after all I might have here some small dilatation of a blood-vessel and accordingly introduced the tube with more care than usual. Within one week the patient developed articular rheumatism that interrupted the endobronchial treatment for six weeks. Dec. 6, 1911, bronchoscopy was resumed and continued for three weeks. After he began to experience relief of his asthma, rheumatism set in again, and on advice of his family physician he went to Hot Springs. A cure of four weeks at that place removed his rheumatic troubles, but in spite of the salicylates and iodids he had taken, his bronchial asthma grew worse, so bronchoscopy was resorted to again. The first four weeks he failed to show improvement. He was just about giving

2. Berkart: Bronchial Asthma, p. 127.

3. von Schroetter, H.: Klinik der Bronchoscopie, Jena, 1906.

up treatment, disappointed, when he commenced to improve rapidly, so much so that in about three weeks his respiration was perfectly free. He was able to enjoy six or seven hours of continuous sleep at night, a pleasure he had missed for many years. Since the middle of March the patient has been free from asthma.

Comment.—In this case, two points were of great interest to us: (1) the pulsation of the left bronchus that was so remarkable, and (2) the fact that the patient became desperate just when his disease took a favorable turn. The case shows how much may sometimes be accomplished even under very unfavorable conditions.

CASE 6.—Mrs. M. G. W., aged 53, was stout, short-necked and absolutely unable to take the least exercise. A short walk of two or three blocks entirely exhausted her. Seven years ago I had removed nasal polypi and had operated on her deviated septum with the hope of abolishing her asthma. She enjoyed free nasal breathing, but remained a sufferer from that dreaded disease with constant attacks. Curvature of the spine was pronounced. In the larynx there were thickening of the posterior wall and paralysis of the transverse muscles. As the patient objected to endobronchial treatment, the larynx was first treated with good results, but the asthma remained *in statu quo ante*. Finally her fear of bronchoscopy was overcome, but it took a great deal of patience and perseverance before a satisfactory inspection could be made. From that moment on she improved remarkably. Masses of mucoid secretion were discharged after the introduction of the tube, then adrenalin (epinephrin) was injected, and finally a powder, consisting of tannic acid and orthoform, was blown in. Another important part of the treatment consisted in restoring the confidence of the patient in her own physical powers. She took to gymnastics slowly, very slowly indeed, but so effectively that the digestion was greatly improved and gradually she became able to sleep quietly at night. She was sent home free from any asthmatic attack, and in a hopeful frame of mind.

Only few of the cases treated have been reported here. They clearly show that after everything else has failed a great deal may be accomplished by the endobronchial method. Of course, there have been failures, but by far the majority of these occurred in patients who consulted me only once or a very few times. On the other hand, I have had two patients who were cured after a single introduction of the tube. The result in these is naturally to be considered as due to suggestion alone. But as long as the patients were cured, I have reason to feel satisfied, no matter how this was accomplished.

In conclusion I would summarize my views as follows: Bronchial asthma may be produced reflexly by disease in different parts of the body. Therefore, every asthmatic should be examined thoroughly, and if gross lesions are found in the nose and throat, in the uterus or digestive tract, etc., they should be treated carefully, after which the asthma frequently disappears. In many other instances, however, this does not suffice. In such cases, the asthmogenous points in certain parts of the bronchial ramification need special treatment and this is accomplished by direct local applications. This, in many instances, is a difficult task, but we are often rewarded by most gratifying and satisfactory results.

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ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. MATTHEWS AND FREUDENTHAL

DR. E. R. LEWIS, Dubuque, Ia.: Keeping in mind the idea that "bronchial" asthma may be largely an anaphylactic reaction, we find it less difficult to explain the discrepancies between cases of pronounced asthma showing slight or undemonstrable nasal disease and those showing very extensive nasal disease with little or no asthma; between highly neurotic individuals with extensive nasal disease and no asthma, and those non-neurotic persons showing extreme degrees of asthma with only slight or undemonstrable nasal disease.

DR. G. F. COTT, Buffalo: I think Dr. Freudenthal has been treating something which does not exist, that is, idiopathic asthma. I believe it is simply a toxemia and that these other conditions, such as bronchitis, etc., are concomitant and not the causes or effects. I have treated a physician's father, who had been treated by twenty-one different physicians each one of whom said he had bronchial asthma. I was called to see him at three or four o'clock in the morning. Now my opinion of a man with toxic asthma is that he doesn't feel very bright and happy about the time of the seizure, but this man was telling funny stories. He had been suffering for a month with a single attack, which you certainly do not find in bronchial asthma. I proposed doing a tracheotomy and he consented. He breathed more easily but died a few days later and we found a small tumor, about the size of a hen's egg, pressing on the trachea which proved to be an aneurysm.

Another patient, on whom I operated on this past Monday, was supposed to have bronchial asthma. I found that he had a distinct swelling over the trachea. I did a tracheotomy under cocain. Then I cut through and opened up the neck and a tumor, which proved to be a sarcoma of the thyroid, was found. In conclusion, asthma is a symptom only and can never be classed as a distinct disease.

DR. DENNIS MCDONALD, New York: Excessive tea-drinking is one of the causative factors in these disturbances. It is surprising to see what proper methods of eating and drinking will do for children who have these spasmodic conditions. The treatment of the intestinal tract also accomplishes a great deal. The next important thing is the matter of baths; the alternate hot and cold baths, though there is nothing like sunshine and the open pool. The next important thing is the examination of such children for adenoid growths and diseased tonsils. These methods will remedy many of the so-called idiopathic asthmas.

DR. JUSTUS MATTHEWS, Rochester, Minn.: In all the cases of this series the patients had a thorough physical examination to exclude, so far as possible, such conditions as those to which Dr. Cott has referred. Several have mentioned reflex asthma, or a reflex neurosis, as a cause of asthma. This has been a long-standing opinion of the profession and has, of course, some facts in its favor. But the exhaustive experiments of Auer and Lewis have proved that all the symptoms of asthma can be produced when all connection of the central nervous system with the respiratory system has been cut off, thus showing that asthma is a local reaction and not the result of a reflex. Dr. Freudenthal's treatment of bronchial conditions is, I think, quite in accordance with the theory of anaphylaxis, and merely points to another source of a foreign proteid.

In many cases of long-standing asthma there is a marked bronchitis or even bronchiectasis, with retained secretions, which may assume the relation of a foreign proteid in cases in which the primary site of absorption has been removed by nasal treatment or operation. The use of epinephrin furnishes another analogy between spasmodic asthma and anaphylaxis. If epinephrin be injected at the same time as the second dose of foreign proteid, it inhibits the anaphylactic reaction just as it does the asthmatic spasm if administered during an attack. The condition of the intestinal tract has a relation to this question, since it is recognized that it has a marked influence on the upper respiratory tract, which might favor the retention or absorption of secretions there. Also, there is the possibility of the foreign proteid entering the blood from the retention of secretions or other substances in the intestines. As to the seat of the disease being primarily in the lungs, I believe that the fact that in early cases there are no pathologic signs in the lungs indicates that the later changes there are the result and not the cause of asthma.

DR. WOLFF FREUDENTHAL, New York: I agree with Dr. Matthews; the lesions in the lungs occur after the disease has

lasted for some time. It seems I have not been understood by Dr. Cott. I have tried to speak of a disease known as bronchial asthma—that is, patients who have spasmodic attacks at night or in the early morning, etc. A man who has had difficulty in breathing continuously for a month and shows afterward a tumor of the trachea has nothing whatever to do with my paper. No matter what name you give the condition, idiopathic or not, the patients were cured. Naturally, if there are spurs or polyps in the nose we would remove them; or if there are tonsils that are diseased we would remove them. But if all these procedures fail to bring on a cure, then we go further, examine the bronchi and treat them by local applications.

INDICATIONS AND CONTRA-INDICATIONS FOR TONSILLECTOMY

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Concerning tonsils, it might be well to divide surgeons into two classes; first, those who want to go to the very bottom of the question regarding the function of the tonsils and base the surgical indications on some theory; second, those who base the indications on the clinical and pathologic facts, as presented, hoping that soon the function of the faucial tonsil will be settled.

It seems to me that the tonsil has some function early in life which is later easily overcome, in many cases, by the raids of bacteria on it. The men with the extreme theories — those, on the one hand, who believe that the gland has an important place in the system, and those, on the other hand, who believe that it has no function and whenever found is abnormal and should be removed — are both wrong.

Dr. Jonathan Wright[1] has given this subject much consideration. He says:

> The function is one of defense against infection. . . . The enlargement becomes pathologic only when it injures the system more by its presence than it assists in whatever physiologic acts of defense it may perform. . . . Many large tonsils exist throughout life without danger or inconvenience to the individual. Of course they so frequently reach such size that they injure the patient's health in cutting off the proper supply of air. . . . The crypts are retorts in which the germs are destroyed or modified so that they live in peace with their host, or they are allowed to pass through in such numbers as can be dealt with by internal processes without the destruction of the host. . . . The tonsil is a definite organ and in man is the most highly developed of all the lymph-nodes.

In infancy it is rarely affected but in early childhood it too often causes trouble in a number of ways, and then after puberty it should practically never give trouble.

The tonsil becomes pathologic only when its presence injures the individual, either locally or generally, not because someone discovers a pair of tonsils in that throat.

An observation that I have stated several times in the past is that the submerged tonsil, which may be quite small, is more liable to be doing harm than the fairly large, discrete tonsil. It is only in the last few years that the tonsil has been judged pathologically other than from its size alone.

The very large discrete tonsil may interfere with proper breathing, the development of the jaw and face, or cause an irritation of the fauces; then it should be reduced. In its reduction, tonsillotomy will do wonderfully well in the majority of cases, but it must be remembered that the remaining portion may reproduce the hypertrophy, or the cicatrices formed over the stump may interfere with crypt drainage and convert the remaining portion into a diseased condition that will allow toxins and germs to invade the system, which the whole gland did not permit before. So it seems reasonable, as it does not increase the patient's risk, that there should be a complete removal of the tonsil.

The tonsil that is more or less submerged is the one that nearly always is to blame for the infective processes about this region and in the neck, and from the neck to the general system.

In peritonsillar abscess, total removal is the only guarantee against recurrence. In deep infections of the neck, when the tonsil is the primary focus, the gland should be removed at the time the infected area is drained.

When the cervical glands at the angle of the jaw become infected either acutely or chronically, the tonsil should be considered the source of the infection, unless something else very definite is found to be the cause, and the sooner the tonsil is totally removed the better the prognosis for the adenitis. I have seen several cases in which partial removal has increased the infection and even produced cervical adenitis, but have yet to see such a condition follow tonsillectomy. A simple adenitis will rapidly disappear and a tuberculous adenitis will be reduced to some extent. This is due to the stoppage of the infecting flow from the primary focus.

In a large percentage of cases of tuberculous adenitis at the angle of the jaw, the tonsil will show tuberculous foci and to remove the tuberculous glands and leave the tonsils is to invite reinfection of the neck. The tuberculosis of the tonsil which leads to adenitis in children is, in a considerable number of cases, of the bovine type and not so dangerous to life as the human type.[2-5]

When a tonsil is overcome to an extent that it is no longer able to take care of the germs that are constantly in its crypts, the lymph-nodes at the angle of the jaw, into which it drains, will become somewhat enlarged, and it is in this class of cases that we see evidence of malnutrition, a low grade of toxemia and under-development. When a child's tonsil reaches this stage it should be removed, and totally, because it is down in the bottom of the crypts that most of the septic invasion is taking place.

Bad crypt drainage seems to be the cause of most of the abnormal conditions and this bad drainage is usually due to the tonsil being buried behind the pillars and in the velum palati. This gives, besides the conditions already mentioned, chronic tonsillitis and recurrent acute inflammations. These conditions are rarely found in a perfectly discrete tonsil. It is also true that tonsils may be badly infected; for instance, allowing tubercle bacilli to enter the neck glands, and yet the patient may give a history of never having had an acute inflammation — the tonsil itself attracting no attention to the unobservant.

Though the etiology of the various conditions coming under the head of rheumatism is as yet unknown, every year more men of ability are joining those who believe that these conditions usually enter the body through the tonsil and that, therefore, its removal is of prime importance. I think that the majority of us have seen patients in whom various conditions of the joints and pains in the muscles have disappeared after attention to the ton-

1. Wright, Jonathan: New York Med. Jour., Aug. 8, Oct. 10, Nov. 7, 1908.

2. Wood, G. B.: Lymphatic Drainage of the Faucial Tonsil, Am. Jour. Med. Sc., August, 1905.
3. Hurd and Wright: Ann. Otol., Rhinol. and Laryngol., June, 1909.
4. Mathews, F. S.: Ann. Surg., December, 1910.
5. Park, W. H., and Krumwiede, C., Jr.: Centralbl. f. Bakteriol., 1910, xlvii, Nos. 22 and 24.

sil. It is possible to relieve some of these patients by local treatment, but manifestly this is not so sure as total removal; however, this is a question to settle for each particular patient.[9-14]

The same position has been taken in chorea,[10] but I have had no experience in this connection.

A submerged tonsil that extends well up into the velum, diseased or not, may cause interference with the normal function of the eustachian tube and, indirectly, with the middle ear, producing tubal catarrh, or one of the acute or chronic catarrhal or suppurative inflammations of the middle ear.

The faucial tonsil has been blamed, perhaps justly, for an appalling list of septic and toxic conditions in different parts of the body, but if the chronically diseased tonsils had been treated in a proper way, this list would have been considerably contracted. It also shows what a serious menace a diseased tonsil can be to the system.

New growths, benign and malignant, should be judged by their size, nature and position and do not come under the subject here discussed.

I do not wish to be understood as favoring tonsillectomy for every diseased tonsil, especially in adults, who will tolerate a certain amount of local treatment. It is foolish to demand that a patient go through the risk and discomfort of tonsillectomy when relief can be obtained by such simple methods as slitting open the infected crypts or by the electric or chemical caustics.

Whenever a new procedure that has merit makes its appearance, there is always a rush that carries a few men beyond the mark and for a time brings discredit on the method. In the last five years the pendulum has swung strongly to the side of tonsillectomy; at the same time it must not be forgotten that tonsillotomy has done an infinite amount of good. But there were too many cases of so-called regrowth of the tonsil until it was generally understood by the laity that tonsils, supposed to have been removed grew again, also that tonsillotomy did not always relieve the conditions for which it was done.

Tonsillectomy is receiving some criticism for the poor results sometimes obtained and the deformities resulting in the throat. Tonsillotomy is a comparatively easy procedure, that was, and is, performed by many besides the laryngologists. Tonsillectomy has been the gradual evolution brought about by the laryngologist seeking a better way to meet certain conditions wherein the old operation of tonsillotomy had failed. Tonsillectomy is by no means an easy operation. It requires much experience and technical skill if a perfect result is to be obtained, regardless of the method used.

I have tabulated 1,530 cards which have been kindly loaned to me by Dr. W. A. Scruton. The cards were filled out by the different members of the house staff of the Manhattan Eye, Ear and Throat Hospital. These cards cover all the different operators with their various methods. There was free primary hemorrhage 147 times (9.5 per cent.). Of these patients fifty-two had the tonsil totally removed, and in ninety-five some tonsillar tissue remained. In twenty-five there was both primary and secondary hemorrhage (1.6 per cent.). Of these seven were total, in eighteen the tonsil remained; fourteen had secondary hemorrhage in which the primary hemorrhage was slight, giving a total of 2.5 per cent. for secondary hemorrhages. In twenty-seven there was profuse primary hemorrhage alone (1.8 per cent.). Of these ten were total, in seventeen tonsil tissue remained. In one case the operation was stopped before the second tonsil was removed on account of profuse hemorrhage. Two of the patients took the anesthetic badly but recovered; these patients had the appearance of status lymphaticus.

These statistics bear out a statement many times made that there is more liability to hemorrhage in partial removal than in total removal.

Contra-indications are about the same as for any other small major operation. The individual case must be studied in the presence of diabetes, renal disease or a non-compensating heart.

It is not well to remove the tonsils in conjunction with some other major operation, such as one for tuberculous glands of the neck, as there is considerably more danger from bleeding after a prolonged anesthetic.

When the temperature is above normal and cannot be accounted for it is better to wait.

Tonsillectomy ideally done should not injure the singing or speaking voice, though a singer may have to learn to use the muscles as they are readjusted. On the other hand, injuries to the pillars, velum or uvula during a tonsillectomy may ruin the singing voice and impair speaking.

Status lymphaticus is an absolute contra-indication (if we could only diagnose this unfortunate condition clinically), as it causes more fatalities than any other one thing.

Hemophilia is also an absolute contra-indication, but fortunately, it is a rare condition. It can be definitely determined by blood examination if suspected from the patient's history. Probably many cases of hemorrhage from the tonsils reported as hemophilia are prolonged bleeding from a vessel so cut that it cannot contract or retract.

I have collected 11,245 cases of tonsils, or tonsils and adenoids in which the patients were operated on at the Manhattan Eye, Ear and Throat Hospital from September, 1906, to September, 1911. Most of these operations were done under ether anesthesia and out of this number two patients died from status lymphaticus, confirmed by autopsy; one patient died on the table; there was no autopsy, and the death was attributed to the anesthetic. One had severe recurrent hemorrhages followed by pneumonia and death.

Dr. Frank S. Mathews has kindly furnished me with the statistics from St. Mary's Hospital for Children. I might state that the method of removing the tonsil with the finger is followed there. From 1900 to 1911 there were 3,702 cases of tonsillar operation with two deaths, one patient acting as if suffering from status lymphaticus; the other was but remotely due to the operation. One hemorrhage was severe enough to require ligation of the external carotid.

Of nearly 15,000 cases between the two hospitals with six deaths, it will be noted that not one was due to hemophilia. Status lymphaticus caused three if not four of the deaths. It might be well to refer to one patient, in reference to hemophilia, who was supposed to have been a hemophiliac. A boy, aged 15, was brought into the hospital one evening practically exsanguinated; he had had the surface of one tonsil sliced off about four hours before. When he was carried to the ward and a tonsil clamp applied he vomited large quantities of blood.

6. Frissel, L. F.: Med. Rec., New York, May 12, 1906.
7. Adler, I.: New York Med. Jour., March, 1906.
8. Beattie, J. M.: Brit. Med. Jour., 1906, ii, 1781.
9. Ingals, E. F.: Laryngoscope, September, 1907, p. 713.
10. Rosenheim, S.: Bull. Johns Hopkins Hosp., November, 1908; Maryland Med. Jour., February, 1911.
11. Brown, L.: Lancet, London, 1900, No. 2, p. 970.
12. Brown, R. C.: Med. Rec., New York, March 2, 1907, p. 341.
13. Goodale, J. C.: Tr. Am. Laryngol. Soc., 1907, p. 228.
14. Poynton, F. J., and Paine, A.: Lancet, London, Sept. 22, 1900, p. 861.

The tonsil clamp did not control the hemorrhage and the house surgeon tried all the usual methods without avail. The next morning I was notified. The patient then had had several intravenous injections of normal saline, the radial pulse was imperceptible and the temperature was in the neighborhood of 102 F. I ligated the external carotid which did not fully control the hemorrhage and later the house surgeon ligated the common carotid with a ligature that had been placed about that vessel to be used if necessary. The mother of the boy was sent for so that a transfusion might be done but he died just before her arrival. She said that the boy bled easily from any slight injury and had become very weak each time he lost one of his first teeth. The autopsy revealed the stomach, small and large intestines distended with blood, but no injuries to the large vessels about the tonsil. This case looks like hemophilia, and certainly death was due to primary hemorrhage.

In conclusion, tonsillectomy is the one operation whenever the tonsils are diseased enough to demand surgical interference, and so far as hemorrhage is concerned it probably involves less risk than tonsillotomy.

15 East Forty-Eighth Street.

REFINEMENTS WHICH RENDER TONSILLECTOMY SAFE, SURGICAL AND SATISFACTORY

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On account of the situation of the tonsil, the radical operation for its removal is beset with certain difficulties and dangers. It is the purpose of this paper to discuss the best methods of surmounting the difficulties and eliminating the dangers.

The difficulties and dangers may be briefly enumerated as those arising from the anesthetic; the obscuration of field and embarrassment of respiration due to flow of blood and mucus, and the danger of hemorrhage. Another difficulty lies in the adequate exposure and illumination of the field of operation These difficulties not only add to the danger of the operation, but interfere with the perfection and artistic detail of the work. My ideas may be best shown by description of the instruments used and the method employed in operating. In this operation I use a number of instruments of my own device. The principle running through them all is the economy of space. The maximum amount of room for the surgeon to work in, with the minimum amount of interference with sight and manipulation.

Every step in this direction adds to the safety of the patient, the perfection of the operation and the comfort and satisfaction of the surgeon.

Patients are prepared for operation by administration of a purgative the night before; generally castor oil is given. The time of operation is preferably early in the morning, as children can be more easily tided over the breakfast meal without missing it so acutely.

Half an hour before operation in adults, ¼ of a grain of morphin and 1/150 of a grain of atropin are administered hypodermatically. In children, a dose is administered in proportion to their years. In very young children only the atropin is administered. The salutary effect of the morphin is apparent in quieting the patient, allaying fear, and rendering the anesthesia smoother, while the atropin helps to dry up excessive secretion which often complicates the administration of ether. Then Crile's experiments have shown that the preliminary administration of atropin furnishes an element of safety in operations on the air-passages, by protecting the heart against reflex inhibitory impulses through the superior laryngeal nerve.

The anesthetic used in all cases is ether. Investigations and statistics have convinced me that ether is a safer anesthetic than chloroform and occasions less anxiety in the administration. The sad chapter of accidents in connection with the administration of chloroform in adenoid and tonsil operations makes me feel that chloroform has no place in such operations. For certain reasons gas has been found unsuitable in the tonsil operation.

Gwathmey's experiments and writings have taught us the value of warm vapor in anesthesia, and for the past six months I have used it exclusively. The apparatus I use is the Cain-McDermott, which I have modified to meet my ideas. The apparatus consists of a bellows worked by foot-pressure which vaporizes the ether. The vapor is driven through a coil of pipe enclosed in a metal receptacle containing acetate of soda. This receptacle is immersed in boiling water for fifteen minutes before using and the soda salt will retain the heat for several hours. The vapor driven through the heated coil is delivered warm to the patient.

As sold, the apparatus is fitted only with a metal mouth-piece to be hung in the corner of the mouth. The modifications I have made are the addition of a mask and nasal tubes.

The patient is anesthetized to the point of relaxation by means of the warm vapor delivered through the mask. When the patient is thoroughly relaxed the mask is replaced with nasal tubes and the operation is begun.

I wish to say that my experience with warm vapor has been most satisfactory. The patient is quickly under the anesthetic, the anesthesia is very quiet and in no case has the patient become cyanosed. In using the metal mouth-piece I found that there was too great an admixture of air and it was hard to keep the patient under; then, too, the mouth-piece was in the way, but when I replaced the mouth-piece with nasal tubes there was no such difficulty. The use of the foot-bellows is an advantage, as it allows the anesthetist the use of both hands to steady the head, raise the jaw and render the surgeon any assistance needed. The use of the foot-pump is a great advantage over the hand-bulb of Pynchon which I formerly used. More vapor is delivered by the increased force from the foot. The squeezing of the bulb by hand is very tiresome and becomes real labor when the operation is prolonged. I can only describe this apparatus as a comfort. Even strong men are kept quietly asleep without the least trouble. The surgeon can go calmly and carefully about his work without feeling the least necessity for hurry. Used in this way it solves the problem of anesthesia in surgery of the oropharynx. It is a great advantage to be able to operate uninterruptedly instead of having to remove the gag and wait while the patient is being reanesthetized.

POSITION OF THE PATIENT

The patient having been anesthetized to the point of relaxation of the jaws, and being flat on the back, the head is lowered slightly, not very much, probably at an angle of 20 degrees. At this angle, the patient seems to breathe better and there is less likelihood of blood and mucus interfering with respiration. The patient is flat

on the back so that the assistant standing at the patient's left may be in a position to sponge and render such assistance as may be needed.

EXPOSURE OF THE FIELD

The mouth-gag is next inserted, and I wish to say that a great part of the confidence I feel in this operation is due to the assistance given by the gag. For some time I made use of the Brandt-Stubbs self-retaining gag and I wish here to acknowledge my indebtedness to it. It has many splendid features but experience has shown defects which I have tried to eliminate The Brandt-Stubbs gag, which is the best of its type, has a tongue-depressor attached which is a very valuable feature. The depressor practically takes the place of an assistant. With the ordinary mouth-gag it is necessary for an assistant to depress the tongue. With the surgeon working in the mouth it is difficult for the assistant to see just where to place the depressor and consequently that instrument slips first to one side of the tongue and then to the other, irritating the surgeon and making the

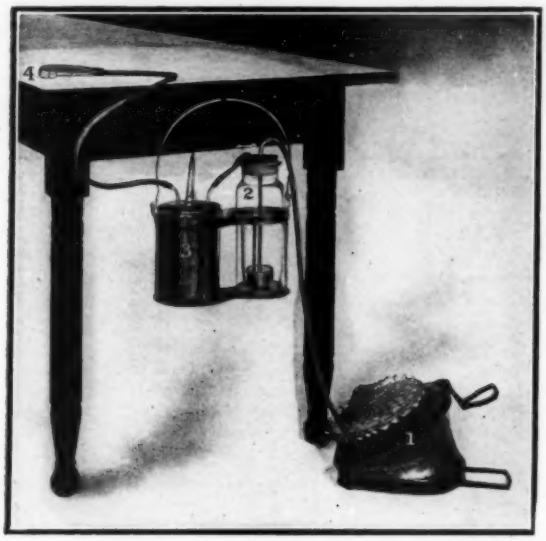

Fig. 1.—Cain-McDermott warm-vapor ether apparatus. (1) Foot-bellows; (2) ether-container; (3) metal receptacle containing acetate of soda; (4) mouth-tube which writer has replaced with a mask to begin anesthesia and nasal tubes to continue the anesthetic after the operation is begun.

exposure of the field unsatisfactory. This depressor being attached to the mouth-gag holds the tongue at a fixed point, and exposes the entire field clearly to the view of the operator. There is, too, one less assistant in the way of the surgeon.

The serious drawback to this gag is that the tongue-depressor is attached in the center and takes up a large amount of very valuable room. The slot for the depressor interferes with the free sweep of the adenoid curet necessitating the removal of the gag and the substitution of another gag when removing adenoids. The depressor being in the center crowds the tongue down on the larynx and sometimes causes interference with respiration. A gag of this kind is hard to insert because the bite-blocks do not come close together. It is necessary to open the teeth an inch before this gag can be inserted. The gag which I use has the tongue-depressor attached at the side. The bite-blocks are fenestrated so that nothing is between the teeth. This gives all the working space possible. The bite-blocks fit into each other so that it is exceedingly easy to insert. The tongue-depressor is adjustable having a lateral as well as a vertical adjustment. This allows first one tonsil to be exposed and then the other. The depressor can be attached or detached instantly. This gag gives a perfect exposure of the field with all the working space possible. Instead of crowding the tongue down on the larynx it exerts a lifting force on the base of the tongue and assists respiration.

ILLUMINATION OF THE FIELD

One of the points on which I insist and on which I lay great stress is the proper illumination of the field. I insist on the field being thoroughly exposed and at the same time thoroughly illuminated. This is accomplished by wearing an electric headlight on the forehead.

Fig. 2.—Author's mouth-gag.

ASSISTANTS

Two assistants in addition to the anesthetist are required. One stands at the left of the patient on a line with the surgeon, and has charge of four sponge-forceps. The other stands just back of the first on the same side. This assistant, usually a nurse, has an adequate supply of gauze sponges and it is her duty to receive the forceps containing the soiled sponges from the first assistant and replace them with fresh ones as fast as they may be needed

GRASPING THE TONSIL

The tonsil on the right side is seized with tonsil-forceps and lifted from its bed and its contour and attachments noted. Often it will be seen that the superior margin of the tonsil is high above the junction of the pillars. Traction will cause the outline of the tonsil to appear beneath the mucous membrane and will serve as a guide to the dissection.

The forceps used is of my own device and carries out the idea running through all my instruments, namely,

to interfere as little with sight and manipulation as possible. The first essential in a good grasping-forceps is that they should take firm hold of the tonsil and not tear out with traction. In order to do this it is necessary that they should have prongs instead of teeth. Any toothed instrument will tear out of a friable tonsil. Having the necessary firmness of grasp, the next essential is that they should occupy as little space and be as little in the way of eye and hand as possible. In order to do this, it is necessary that the arms should be as slender as is consistent with strength, and when closed the two arms should present the appearance of a single arm. Carter recognized this principle when he devised his tonsil-screw, and I wish to express my admiration and appreciation of it. For a firm tonsil it is an ideal instrument but we must have something that will not tear out of a friable tonsil. In order to give necessary grasping area the prongs take the form of a semicircle at the point where they come off from the arms. This permits the two arms to come together like a single rod and at the same time gives the prongs plenty of grasping surface. The arms of the forceps should be long enough to permit the hand grasping it to be out of the way. The forceps takes the form of a pair of calipers. This is an additional factor in space-saving, as the hinge joint is at the end instead of in the middle.

Fig. 3.—Author's mouth-gag in position in patient's mouth exposing left tonsillar region. By means of its lateral adjustment it can be moved over and expose the right tonsil in the same manner. The tonsil has been enucleated and the fossa has begun to fill with follicular tissue. Note that there is no interference whatever with the working space in the mouth.

DISSECTION

The dissection is started at the anterior superior junction of the tonsil and the pillar. The instrument used is the right-angled knife which I have devised from the Leland knife. There are essential differences. The blade is shorter. I often found that the Leland knife was difficult to manipulate in the throat of a small child on account of the length of the blade. The blade has a rounding sharp point instead of a sharp or probe point. A great convenience is having both blades on one handle, thus doing away with the necessity of laying down one instrument to pick up another and allowing the surgeon to keep his eye on the field; it also does away with the necessity of searching among the other instruments for the one wanted. The dissection is for the most part a semisharp dissection. The side of the blade is used as a blunt dissector when blunt dissection can be accomplished without too much force and traumatism. When much force is necessary, I believe that sharp dissection is preferable. As the attachments are severed it will be noticed that the tonsil gradually rises from its bed.

When the dissection is complete the tonsil can be lifted from its position between the pillars and is attached only to the constrictor. I have learned that the dissection is not complete until the tonsil can be dislocated in this manner. Any attempt to remove it before this stage is reached will result in only a partial removal and will require a second effort. The anterior pillar is first separated, then the supratonsillar attachments and lastly the posterior pillar. During the progress of the dissection the blood is sponged up by an assistant as fast as it appears and the field of operation is kept clean. Good exposure, good illumination and good sponging make every stroke of the knife visible and add greatly to our sense of safety and security. When the right tonsil is freed from its attachment to the pillars and only remains adherent to the constrictor it is grasped with the forceps put on the stretch and severed with the cold wire snare. As soon as the tonsil is removed the assistant thrusts a sponge on a sponge-forceps into the cavity and makes pressure till the first rush of blood is over.

My tonsil hemostat is then applied and the dissection of the other tonsil is proceeded with. The hemostat has an arrangement whereby the gauze pad can be adjusted instantly instead of having to be tied on as is the case with most hemostats. This enables one to save time when it is desired to apply it quickly and is a convenience at all times. The application of the hemostat renders it unnecessary to wait until the hemorrhage has stopped, and allows the operator to proceed at once to the dissection of the other tonsil without loss of time. The application of the hemostat shortens the operation, at least, five minutes.

Fig. 4.—Tonsil forceps.

When the second tonsil is removed pressure is made with the sponge forceps until all hemorrhage is arrested. The patient is not allowed to leave the table until the throat is dry. The pillars are drawn back with retractors and carefully inspected for bleeding points, and to see if any tonsillar tissue has been left. If any remains, it is removed with the snare. If after removal there is an apparent difference in the size of the two tonsils, it is well to search carefully, for it is my experience that after removal the tonsils are approximately the same size, however different they may appear while in the throat.

I consider this operation safe for the reason that every stroke of the knife is made under the guidance of the eye. The patient is under the anesthetic, absolutely quiet, the field is fully exposed and every stroke of the knife can be taken with the most painstaking care. The thing most to be feared is hemorrhage. If troublesome hemorrhage should arise we are in the very best position to cope with it. The bleeding points can be located by sight and if it is an artery it can be grasped and ligated if necessary, or if it is a vein direct pressure can be applied.

WHY GIVE AN ANESTHETIC?

I believe that a general anesthetic should be administered in the first place for the mental and physical comfort of the patient. It is repulsive to most people

to have any kind of manipulation in the mouth. It generally provokes retching and gagging, which is unpleasant. Then the mental effect of the cutting is terrorizing even if local anesthesia abolishes the real suffering. This is from the standpoint of the patient. From the standpoint of the surgeon the gagging and retching keep the tonsils and pillars in constant motion and increase the difficulty of grasping them and placing the incisions properly. This is also an element of danger. The necessity of spitting out the blood causes constant interruption. In comparison with these difficulties the great ease with which one does his work with the patient completely under anesthesia imparts a sense of security and satisfaction that is comforting. The surgeon can proceed calmly and carefully to his work undisturbed by these annoyances. The blood can be mopped up and the hemorrhage limited by pressure with the sponges. After removal, pressure can be maintained until the hemorrhage is stopped and the throat rendered clean and dry before the patient leaves the table. Searching for a bleeding point in a pharynx that is moving rhythmically back and forth, accompanied by vomiting and spitting of blood, is very different from a pharynx that is absolutely at rest. Pressure can be applied, bleeding points seized, twisted or ligated, or the pillars sutured with ease. Then again why should we withhold the blessings of general anesthesia from patients requiring this operation, when we extend it in so many operations requiring less time and having fewer unpleasant features?

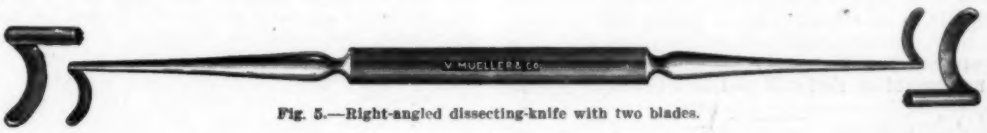

Fig. 5.—Right-angled dissecting-knife with two blades.

HEMORRHAGE

In more than six hundred tonsils removed in this manner covering a period of two years only two cases of slight secondary hemorrhage have occurred. I cannot attribute this entirely to good fortune, as with the guillotine operation there were always several cases of hemorrhage each year. A further argument against the good luck theory is that this series of cases contained a large proportion of adults in whom we are taught to expect a much greater tendency to hemorrhage. I attribute this freedom from hemorrhage in the first place to careful dissection in a fully exposed and illuminated field, unobstructed by blood or mucus; in the second place, I attribute it to the careful checking of hemorrhage by sponge pressure, grasping of bleeding vessels, and the invariable rule of having the hemorrhage completely arrested before allowing the patient to leave the table or come out from under the anesthetic. This is not done in a perfunctory way but the pillars are drawn back with retractors and the cavity carefully inspected.

ADAPTABILITY

I claim for this operation that it has the great advantage of being applicable to any type of tonsil and it is an advantage to have a single technic. Any tonsil that can be removed at all can be removed in its entirety by this method and there will be no necessity of changing from one method to another after beginning the operation.

From a haphazard carelessly executed procedure which any novice felt fully competent to undertake, tonsillectomy has been raised to the dignity of a surgical operation, demanding care, skill, judgment and experience. The operation as formerly practiced was practically a leap in the dark. The instrument was introduced, the tonsil amputated and luck trusted to to stop the hemorrhage. If the hemorrhage did not stop the operator was at a great disadvantage. With the patient gagging and retching the bleeding point was difficult to locate and still more difficult to grasp or compress.

The operation as I perform it requires from fifteen minutes to an hour. The tendency to hemorrhage and the amount of dissection required is what prolongs the operation. There has always been an idea prevalent among the laity that removal of the tonsil has a bad effect on the voice. No effect was observed in this series of cases other than beneficial.

In an interesting article on the results of enucleation in fifty-three cases, J. H. H. Pearson[1] of the Royal Edinborough Infirmary reports an astonishing number of cases of deformity of the soft palate and pillars. In only eighteen cases were the palate and pillars left without deformity. There was marked asymmetry of the palate with deviation of the uvula from the middle line in nineteen cases; lowering of the soft palate on one or both sides in thirty-four cases.

No such results as these were observed in my case. In one case, a portion of one posterior pillar was removed and in another the uvula was amputated, but in no case was there observed any asymmetry of the palate. I attribute this to the exceeding care with which the dissection is carried out, the tonsil being hugged closely at all times and every effort being made to spare the surrounding structures.

There seems to be no way of preventing the fusion of the anterior and posterior pillars in the process of healing. If we can find some way to carry out the suggestion of Hudson Makuen, to leave the capsule intact, even this may be accomplished.

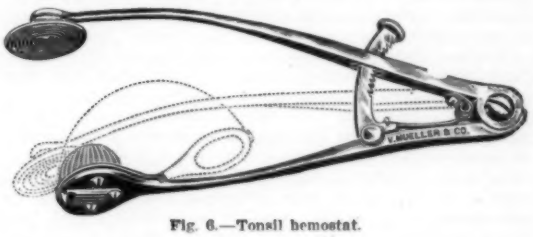

Fig. 6.—Tonsil hemostat.

The oldest patient operated on was 55 years of age. There was a large proportion of adults in the series. It was not noticed that there was any greater tendency to hemorrhage in adults than in children.

In the case of one adult I was notified two hours after the operation that some bleeding was taking place. I returned to the hospital and found some venous hemorrhage from the supratonsillar fossa on the left side. I applied the tonsil clamp, which stopped it at once. There was no recurrence of the bleeding.

1. Jour. Laryng., Otol. and Rhinol., May, 1912.

In the case of a frail boy of 14, I was notified the next day that he had been spitting up blood. I went to see him and found evidence of bleeding from the right tonsil, but no hemorrhage was taking place at the time. I advised immediate removal to the hospital but the mother was averse and promised to send him at once should the bleeding recur. They reported next day that he spat up blood at intervals till 5 a. m., when it ceased absolutely. He passed a quantity of dark blood by bowel and I am satisfied that he swallowed considerable blood. It was noticed by all at the operation that the blood caught in the basin when the adenoids were removed showed absolutely no tendency to clot. It ran around the basin like so much water and at no time gave any indication of congealing.

This paper is not an attempt to exploit any particular method of dissection. It is a plea for the surgeon to place himself under the most favorable conditions possible for performing the operation. Judging by the dangers to be met, the difficulties to be overcome and the results to be accomplished, I believe that tonsillectomy is an operation worthy of our very best skill. Let us spare no effort that will contribute to its perfection and no precaution that will add to its safety.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. CULLOM AND HURD

DR. T. C. WORTHINGTON, Baltimore: The complete extirpation of the faucial tonsil is now a well-recognized therapeutic measure, and deservedly so. I feel sure both from observation and from personal experience that the operation can be rendered one of comparative safety. To accomplish this, the refinements of technic must be strictly adhered to in every case. Safety requires constant caution. My patients are never given morphin and atropin until on the operating-table, and then only if there is reason to think that the ether will be resisted. I do not administer these drugs to children. The anesthetic is always in charge of a specialist in anesthesia or one well trained in this work. Anesthesia is begun with nitrous oxid gas and oxygen, followed by warm ether vapor. The instruments used are a special mouth-gag which when in position rests on the anterior molars and which has a metal tube attached for the administration of the ether vapor; a tonsil-knife slightly curved on the flat and very sharp (THE JOURNAL, May 25, 1907, p. 1671); a slightly sharpened dissector, a special grasping and artery forceps, a pillar-retractor and a tongue-retractor. Notwithstanding the use of an electric head-light, the room is not darkened, so that the color and breathing of the patient may be easily observed.

The functions of the posterior pillars are much more important than are the functions of the anterior pillars, and when they are wounded or torn there is usually a loss of symmetry in the pharyngopalatine arch. This may result in impaired hearing or in alteration of the voice, in proportion to the amount of damage inflicted. For this reason the tonsil should be separated from its posterior pillar and from the supratonsillar fossa with care, and without force. It should not be torn from its attachments. Before the tonsil is entirely separated from above, the artery passing down from the supratonsillar fossa and along the posterior pillar is clamped and later tied. The other vessels are smaller and more easily controlled if the dissection includes only the tonsil with its enveloping capsular membrane; but this is not always possible. There is usually very slight loss of blood during this operation, and there should be none afterward. The after-treatment consists of rest in bed for a few days, with the use of all the ice or water which will be taken. This is begun as soon as the patient regains consciousness. The time consumed by a complete tonsillar excision, including the anesthetic and the control of all bleeding and oozing, is from thirty minutes to perhaps an hour. This difference of time is unimportant, because during the later stages of the operation, the patient is getting almost no ether.

DR. JAMES T. GWATHMEY, New York: The safest and best time at which to operate is about one hour before the patient is expected to awake, especially for nervous children who are afraid of the operation. It requires no special technic to put a child that is already asleep under the anesthetic; merely a sponge on an artery forceps, a few drops of chloroform, as needed, and ether when automatic respiration occurs. This method is also good for weak children.

By statistics of over 26,000 administrations, gathered from all over the United States, it is shown that one of the safest methods, safer than the gas-ether sequence is the chloroform-ether sequence. This was a surprise to me and will no doubt be to you. These statistics were not doctored but were sent in by the different hospitals. Of course, in my own work I vary the technic according to the wishes of the different surgeons for whom I give the anesthetic. When allowed to use my own preference, I start with some perfume, generally with one or two drops of the essence of orange, then chloroform, then change to ether. It is the only odor stronger than that of ether. Even if you do not want the chloroform-ether sequence, you may start with the essence of orange. In this way a quiet form of anesthesia is produced, which may then be continued with any special apparatus such as Dr. Cullom's. Dr. Grayson has reported 3,800 chloroform anesthesias without a death. I have had one experience, which though it did not terminate fatally, was alarming, and will last me a life-time in chloroform anesthesia for a tonsil operation. The chloroform-ether sequence is, I think, very safe. The gas-ether sequence produces an engorgement and more hemorrhage than the chloroform-ether method.

No deaths have been reported with the essence of orange-chloroform-ether sequence nor have any deaths been reported from chloroform-ether sequence in children. The fatalities in early chloroform anesthesia have all been in adults and usually strong, robust men. It is not necessary to hold a child that is reasonable in administering the essence of orange-chloroform-ether sequence. The change to ether should be very gradual, as rapidity produces swallowing or convulsive movements. If the warmed ether vapor as recommended by Dr. Cullom produces no coughing or unpleasant sensations it is not necessary, as a rule, to hold the child, but warmed vapor should be used continuously.

The principle of operating under a continuous narcosis and with a bloodless field cannot be too strongly insisted on. No man can do his best work hastily and with the field of vision cut off by blood. The continuous narcosis also allows a last look to see whether or not there are any bleeding points.

DR. HOMER DUPUY, New Orleans: For three years both in private practice and in my work at the Charity Hospital I have been employing heated ether in my operations; I commend the efficiency of this method. In the first place, it produces absolute narcosis, uninterrupted by the usual gagging when the simple cone is used, and it notably shortens the time of operation. As I am sponsor for the Caine-McDermott apparatus, I must praise it. In a four years' experience during which I was occupied in devising an apparatus of this nature, I must concede that the one shown by Dr. Cullom meets every indication. Dr. Cullom failed to make the point that we must first begin anesthesia with the cone and after securing profound narcosis the apparatus is put into play. This reduces the irritation that comes from direct contact of so concentrated a form of ether with the throat. In hundreds of experiences we have found that while the nasal attachment assisted materially when operating on adults, it is not so reliable in producing uninterrupted narcosis as that obtained by the mouthpiece. I believe that this method of heated vaporized ether anesthesia greatly shortens the period of operation, reduces shock, and allows more time for the application of the delicate technic incidental to throat surgery.

DR. GEORGE L. RICHARDS, Fall River, Mass.: When I sent out requests all over the world a few years ago concerning this subject, 90 per cent. of the replies said that there was only one procedure in the way of treatment, and that was surgical. I am glad to see less radical measures suggested for use in suitable cases. The American Laryngological Association has begun an inquiry into this subject, the report to be made

after three years, with the hope of arriving at something definite. The subject of the physiology and pathology of the tonsil has been neglected by text-books and investigators. It deserves attention.

DR. F. VICTOR LAURENT, Pittsburgh: Tonsillectomy may cause a decided change in the voice. It will create a new condition of acoustics in the throat, and may change the quality and range of the voice. It may make the voice larger and deeper but that is not necessarily an improvement. Most people think the vocal cords are the only thing concerned in voice production; the position of the larynx is also of great importance—being low for the chest register, in a middle position for the medium register, and high for the upper register. After a tonsil operation there is sometimes a slight constriction of the pharyngeal muscles concerned in the elevation of the thyroid cartilage. This interferes with the motility of the larynx, marring the flexibility of the voice and making it more difficult to sing the tones of the upper register.

DR. B. D. SHEEDY, New York: I have seen several cases in which the voice has been decidedly injured following careful enucleation of the tonsils. I would advise our profession to be very careful about doing tonsil enucleations on singers. One patient who came under my care after a tonsil enucleation reported that she had lost her means of making a living through the change in her voice following the operation. Many patients have a slight nasal intonation of the speaking voice due to the contractions of the cicatricial tissue narrowing the opening into the nasopharynx.

DR. J. H. ABRAHAM, New York: In 1900 I presented a paper before the Alabama Association on the subject of acute and chronic infections in which I contended that we were dealing with a septic condition requiring surgical treatment—slitting of the tonsils and removal of the caseous infectious material. The difficulty was in getting down to the depth of its capsule. In 1906 I did my first enucleation, a finger operation; since then I have been greatly interested in the radical operation and have presented several instruments before this Section; about four years ago I presented a grasping-forceps and artery forceps which have been greatly modified since. The forceps I prefer has no teeth, but simply fenestrated blades.

As to anesthesia, the other day I operated on a child, 5½ years old, it was the fourth operation he had had for adenoids and the third for tonsils. Chloroform was administered in all of the above operations and it required one hour of hard work to revive the child in the last operation. I prefer ether. I always operate with the patient in the prone position. I have for several years discarded intranasal administration of ether. It may set up inflammation of the nasal accessory cavities, and I therefore prefer to give it through the mouth. After the child is completely anesthetized, a curved cannula with proper connections is all that is required. I have had several accidents with Dr. Hurd's instrument for retracting the pillars and separating them, and am glad to see that he has modified it.

DR. H. W. LOEB, St. Louis: If the physiology of the tonsil is not understood, the therapeutics, other than surgical, is absolutely a page in our work without a mark in the way of knowledge. I have slit tonsils and burned them and made applications and the tonsillar trouble went merrily on. It stopped for a while and then continued; I speak, of course, of the tonsils of adults. It seems to me that Dr. Cullom has presented a nice way of doing the operation, but I fail to see the value of such detail. If I spend fifteen minutes to an hour to remove tonsils, I think it is entirely too long. Whenever possible I commend the new plan of Sluder in which a series of instruments is not necessary. The operation is done with one instrument held in the right hand. Those of you who will give it a trial will find the time of operation greatly lessened and the removal of the tonsils more effectual. Warmed ether vapor may be all right, but there is grave doubt whether it can be warm under the usual method of administration.

DR. W. L. BALLENGER, Chicago: I wish to present in this connection my newer method of doing the Sluder operation. The instrument is an angiotribe and a tonsillotome combined. It has a dull blade with which the tonsil is clamped; before a drop of blood runs the tonsil is out of its bed and the angiotribe applied. It can be left there any length of time and there will not be a drop of blood in the throat; after two or three minutes to allow clotting, with the screw I force home the sharp blade which cuts off the tonsil. It is free in the throat and taken out. The sharp blade is turned back again, a spring is touched at the side of the instrument and the angiotribe is removed and the operation is complete.

DR. FRANCIS P. EMERSON, Boston: I do not wish to add to the technic of tonsillectomy or its indications in children, but would call attention to that type of tonsil in adults which is the cause of systemic conditions, and which I think we are finding more frequently as we perfect our technic of examination; that type of tonsil which we call the persistent infantile, degenerate or submerged tonsil. As a portal of entry the tonsillar area is becoming more and more important as we study this class of cases in adults, and we want clearly a definite indication when to remove them, as Dr. Hurd has said. If there are systemic conditions in the adult, such as myalgias, joint troubles, endocarditis or adenitis, this area should be very carefully examined. My point is illustrated by the case of a patient, aged 56, who gave a history extending over eight or ten years, of slight sore throat combined with malaise, which he attributed to overwork. In January he had a slight sore throat with soreness in the left shoulder; three weeks later an exacerbation of the throat trouble, with lameness all over the body, which was so marked, that he was in bed three months, unable to dress himself. Two very able throat men had examined him and pronounced the throat negative. His family physician, after a very careful physical examination, including the blood and sputum, still believed that the origin of his trouble was in his throat and advised his coming to Boston. On entering the office he walked like a man with severe lumbago. In the throat examination there was no indication of inflammation of the mucous membrane; the pharynx looked normal, but on retracting the anterior pillar on the left side and introducing an eustachian catheter, there was expressed from a submerged tonsil a half teaspoonful of pure pus. If you examine these cases in this way, retracting the anterior pillar, and expressing the contents of the tonsillar mass, you will be surprised to find how many times what looks to be normal tissue is simply an enclosed abscess; these cases contain a large number of streptococci, which are capable of producing serious systemic conditions.

DR. C. F. WELTY, San Francisco: Tonsillectomy is the only operation that should be done on the tonsil. The indications include hypertrophied tonsils which interfere mechanically, tonsils that have cheesy deposits, buried tonsils, tonsils that are associated with enlarged glands, peritonsillar abscess, recurrent tonsillitis and acute otitis media. In every case of acute otitis media tonsillectomy and adenoidectomy should be performed at the time of the acute infection. It should also be done in cases of acute exacerbations of heart trouble, rheumatism, chorea, all cases of underweight, healthy in other respects.

The mode of examination with the eustachian catheter is one of the best and you will often find indications for tonsil removal in this way which otherwise would not be suspected. Patients who have recovered from acute tuberculosis should have their tonsils removed, because the germs remain in the tonsils as a reinfecting agent. Bromid of ammonia administered by rectum in children under 4 is useful to keep them quiet after operation. It is not necessary to have assistants. All the operator needs is a nurse to hold the tongue-depressor and I think the one I showed at the meeting last year is the best for the purpose.

DR. W. W. CARTER, New York: In the snare operation, the instrument I devised a few years ago, the spiral tenaculum for catching the tonsil, will hold a friable tonsil better than anything else if engaged deep enough. In operating on submerged tonsils, it can be inserted into the small slit between the pillars and by pulling on the tonsil the full outline is shown. I use the Seiler knife for separating the pillars and generally I do not have to cut at all, for by traction with

the spiral tenaculum the tonsil is lifted from its bed. The Seiler knife is then inserted just behind the anterior pillar and the tonsil is pried out. The snare is easily adjusted over the tenaculum (which is a small straight rod) and the tonsil removed with no injury to the pillars.

DR. H. B. LEMERE, Omaha: Many of our patients have submerged tonsils with infectious material deep in the crypts which will make its appearance only on expression. I have found in the last three or four years that the use of Bier's cups on the tonsils is easy and efficacious, both as a diagnostic and therapeutic measure. They are easily applied and in just such cases as Dr. Emerson has referred to the pus can be drawn out and a bacteriologic examination made.

DR. LOUIS OSTROM, Rock Island, Ill.: I have had a good deal of hemorrhage following tonsillectomy. Frequently my patients have had a dry throat when they left the table but as soon as they woke up, cried and struggled they would begin to bleed. I always instruct the nurse—and especially the mother who can be absolutely depended on—to watch the patient carefully as to swallowing and if there is a rate of swallowing faster than five times a minute to let me know at once.

DR. H. F. PYFER, Norristown, Pa.: Methods of tonsil operation have had a slow progressive growth since we have discarded tousillotomy. Every year that I have been attending the American Medical Association meetings I have gone home with a handful of instruments that the leaders of our meetings have recommended as perfected and needed for a good dissection; but these instruments have in some way failed to do the work. There were still occasional alarming hemorrhages, still retained portions of tonsils, still conditions to meet. Ballenger has shown, in his book, the ideal tonsil dissection with the scalpel, but now he has retrograded to a quicker method, unquestionably safer and more accurate. To my mind it is not the rapidity of the operation but the thoroughness and the care that should be the chief consideration. Searching after many disappointments for an accurate, safe way of removing tonsils I found it when Lee Cohen of Baltimore devised his method of tonsil dissection. With a modified tonsil-knife he carefully dissected the tonsils from the pillars, then retracted the pillars and picked up the numerous little bleeding vessels and tied them off after clamping them with a modified Jackson hemostat. Occasionally I have found it necessary in cases of oozing to suture the pillars with catgut, using McReynolds' needle-holder and needles. I can leave the patient without any fear of a hemorrhage following the operation. The healing is prompt and painless. The suggestion to wait until we have severe hemorrhage and then tie and suture is fallacious, for physicians who wait for this time will discover that they have not sufficient surgical dexterity or developed technic to do the work, and lives will be jeopardized if not lost by their bungling work. Furthermore, no one knows how great the hemorrhage is going to be or how large a blood-vessel is cut. The instruments absolutely necessary for a safe tonsil operation are a half-dozen Jackson hemostatic forceps, any good dissecting knife and McReynolds' needle-holder and needles.

DR. G. F. COTT, Buffalo: As to the employment of the Jackson hemostatic forceps just referred to, I want to say that Jackson does not tie; he catches the vessel and twists it. I have done that a number of times and do not find it necessary to tie. Dr. Hurd states that four of his patients died from status lymphaticus. Status lymphaticus, as an entity, does not exist and so patients cannot die from it. There is a condition of poison which causes the trouble. We must extricate ourselves from the long and well-beaten path of tradition without fact. If you ascertain the cause of so-called status lymphaticus and attack that, your patient has a good chance to recover.

DR. G. W. MACKENZIE, Philadelphia: Apropos of the physiology of the tonsils, I do not know just how many physicians here practice the systematic examination of the lingual tonsil. A year or so ago I had several cases referred to me by general practitioners complaining of spasmodic croup with the request that I remove the tonsils, hoping thus to cure the attacks. I removed them as thoroughly as I knew how but the croup continued and in some it was increased. I was surprised to find that in a number of these children in which the tonsils had been removed subsequently there was enlargement of the lingual tonsil. We should examine these cases more thoroughly before operation and take into consideration the whole of Waldeyer's ring.

DR. B. R. SHURLY, Detroit: It seems to me that it is necessary that certain definite principles of procedure in the operation should be thoroughly carried out by all of us who are interested in this work. One is, to my mind, the question of anesthesia. I feel that it would be a great mistake to allow the discussion to convey the idea that it is correct to use chloroform anesthesia in any of these operations, at any stage of the operation or at any time. It certainly seems to me to have been definitely decided that we have but one safe anesthetic for this work, that is ether. We talked about that for twenty years and we should stick to our conclusions in the matter.

DR. HOMER DUPUY, New Orleans: This Section can hardly go on record with the statement unchallenged that we cannot produce warm ether vapor. In the Cain-McDermott apparatus we first vaporize the ether and as such it is passed through a heated coil, acetate of soda being used, when it is heated in this last receptacle, from which it is carried warmed to the mouth or to the nose of the patient. It is merely a question of physics and we must admit that ether can be vaporized and heated.

DR. M. M. CULLOM, Nashville, Tenn.: In reply to Dr. Loeb's question the time referred to in the paper means the entire time from the beginning of the anesthesia until hemorrhage is stopped and the patient is removed from the table. I have found by accurate timing that the average time for inducing anesthesia in children with warm ether vapor is four minutes and in adults eight and a half minutes. The anesthetic was not pushed, but the anesthesia induced gradually. If the anesthetic is "crowded" the time can be reduced considerably. The actual time of operation from the insertion of the gag till the removal of the second tonsil averages eighteen minutes. About five minutes more is required to check the hemorrhage from the second tonsil.

DR. LEE M. HURD, New York: Prolonged ether anesthesia seems to increase the liability of hemorrhage. The singing voice will not be injured by tonsillectomy if perfectly done, but a faulty technic with injuries to the structures about the tonsil is more than likely to injure the voice. Rheumatic conditions do not necessarily have to be preceded by an acute inflammation of the tonsil. It can very well be due to a tonsil that would not attract the attention of the unobservant.

I agree with nearly all the indications but it must not be overlooked that acute suppurative otitis media can be due to infected nasal sinuses. In regard to the anesthetic, in two of the cases of death from status lymphaticus ether was used; if chloroform had been the anesthetic it would have been blamed for the result; chloroform may be more poisonous in status lymphaticus but ether is also dangerous.

CHRONIC LARYNGEAL STENOSIS; TREATMENT BY PROLONGED INTUBATION

HOMER DUPUY, A.M., M.D.

NEW ORLEANS

The many difficulties which encompass us when dealing with chronic laryngeal stenosis will test to the utmost the patience, foresight and mechanical ingenuity of the surgeon. Months, and even years, may be required in overcoming the obstruction. My experience confirms that of other observers relative to the greater frequency of this stenosis in children. This one factor adds materially to the problem *per se* for there are also local and regional difficulties which present themselves in the treatment of this condition. The instability of the muscular and nervous mechanism of the larynx, incident

to prolonged yet unavoidable pressure of an intubation tube, renders this organ all the more susceptible to intercurrent and sudden adductor spasm of the glottis. Fright and want of self-control, then, are the elements in these young subjects which may readily precipitate such a crisis as adductor spasm. The method of overcoming this obstruction must necessarily hinge on our conception of its causation and its pathology.

In the light of such evidence as is furnished by a notable contribution from J. Rogers, Jr.,[1] and by six cases which I report in this paper. O'Dwyer's dictum, that retained tube cases are the direct result of traumatism induced by faulty intubation, is no longer acceptable. It is timely to recall that in pre-intubation days chronic laryngeal stenosis in children not infrequently led to long retention of the tracheal cannula. While the literature on this subject is very meager, at least in recorded experiences, the greater number of observers are unanimous in their conviction that, in children more particularly (excluding the presence of papilloma, of granulations and cicatricial changes around a tracheal cannula), hypertrophic laryngitis with a focusing of the hyperplasia in the subglottic region is the logical explanation of this form of stenosis. While the original affection necessitating intubation may be diphtheritic, the more permanent and deep-seated exudative inflammatory changes are scarcely to be attributed, in these days of serotherapy, to a continuous and active diphtheritic process. The original infection may have spent its force while the exudative alterations continue and they must be regarded as a sequel of diphtheria. Why such uncommon tissue changes should follow in the wake of diphtheria in such a comparatively small number of proved laryngeal diphtheritic infections, and not in others, remains unanswered. On the other hand, it is proper to reiterate and reinforce the statement that while diphtheria, by microscopic and clinical evidence, has been proved the undoubted cause for these stenoses, there is indisputable proof that diphtheria should not always bear the brunt of the blame. In my series of six retained-tube cases in only one instance did the microscope give a positive result as to diphtheria.

The cause of these obstructions was forced on me in two instances (Cases 2 and 3), when by a direct inspection through a tracheotomy wound a diffuse infiltration with a velvety appearance was plainly seen to occupy the subglottic region and that portion of the trachea which is encircled by the cricoid cartilage. In these areas there was a marked narrowing of the lumen of the respiratory tract. Further confirmation of these phenomena was obtained by performing intubation. The tube readily passed the glottis, but invariably encountered resistance in the subglottic region.

To O'Dwyer belongs the credit of first suggesting that long-continued dilatation by means of intubation tubes offered a reasonable prospect of success in this condition. Gradual, systematic and continuous dilatation with a special intubation tube, one having a low retaining swell, or with a tube having a silver pin attachment for permanent fixation, have proved, in my experience, distinct advances in the treatment of this stenosis. It is a common experience that in hypertrophic laryngitis, with a subglottic stenosis, the ordinary intubation tube seldom remains *in situ* for more than twenty-four hours. Dangerous auto-intubations continually threaten to thwart our best efforts. Tracheotomy is frequently, but improperly, resorted to for this very reason. But it is usually inadequate and only retards the final cure. About six years ago Dr. L. De Poorter and myself devised a set of metal tubes with a low retaining swell. We called these our "fat tubes." This retaining swell is so placed that it impinges on that portion of the subglottic and tracheal areas which are the usual seat of the constriction so frequently associated with hypertrophic laryngitis. This "fat tube" certainly reduces the possibility of auto-extubations and, moreover, effectively carries out the all-essential principles of dilatation. Should this fail us, the fixed intubation tube holds out a promise of success. It is a hard rubber golden lined tube with a perforation on its anterior surface, at about its lower middle third. A screw pin fits in this perforation. An incision through the trachea, the tube being properly placed in the larynx, gives access to the perforation for the fixation of the pin. The line of incision is then closed above and below the pin. Permanent fixation is thus secured. Rogers first devised the pin and tube attachment made of hard rubber. This pin swells in the tube and is removed with difficulty. I have practically overcome this objection by substituting a silver screw pin in a hard rubber tube. This tube can be easily removed to meet the various indications and if replaced within a short period it will be feasible to screw it in without further surgical measures.

Fig. 1. — Dupuy - De Poorter low retaining-swell intubation tube.

Fig. 2. — Intubation tube with silver pin for permanent fixation in the larynx.

The sum of my experience, excluding a patient under treatment, totals six cases. One case was of syphilitic origin, one was due to diphtheria; in three instances cultures were negative as to diphtheria. With the exception of one adult, my subjects were under 3 years of age. There were four successful outcomes and two deaths. One failure, Case 3, resulted from an avoidable accident; the other, Case 2, from an intercurrent bronchopneumonia. The periods of intubations extended for from one month to one year.

CASE 1.—Jones F., aged 30, presented a syphilitic laryngeal stenosis which occasioned a very distressing and increasing dyspnea. The cicatricial contractions reduced the glottis to a mere slit. Under cocain anesthesia a No. 8 metal intubation tube of the Farroud set was with some difficulty introduced. The tube gave the required relief and remained *in situ* for about a week when a specially constructed rubber tube, with a rubber pin for permanent fixation, was introduced. An incision over the trachea, the tube in position, gave ready access to the perforation in the tube. The line of incision was closed above and below the pin. This tube was only removed about a month later. Dilatation was sufficient to allow comfortable

1. Rogers, J., Jr.: Chronic Obstruction in Larynx and Trachea, Am. Jour. Med. Sc., November, 1905.

breathing. Further to insure this good result the larger size metal intubation tubes were introduced without fixation for another month and then extubated. The patient, seen one year after dilatation, had experienced no further trouble. The usual systemic treatment was resorted to during and after the intubation period.

CASE 2.—Myrtle M., aged 12 months, was referred by Dr. John J. D'Aquin, and intubated by me for increasing and persistent dyspnea. For a period of twenty days several extubations and three auto-extubations necessitated immediate reintubations. On the twenty-fifth day after the first intubation the removal of the tube was followed by normal breathing for twelve hours. The obstruction, however, recurred at the thirteenth hour, requiring a reintubation. A low tracheotomy was determined on to safeguard life in the event of auto-extubations. For one year with the tracheal cannula in position systematic dilatation by tubes progressing from the No. 1 to the No. 3 (Farroud set) was the method of procedure. This finally secured sufficient dilatation to allow free breathing without the tracheal cannula and intubation tube for a period varying at first from a few hours to almost twelve hours. Even under these apparently favorable conditions the cannula was always replaced when she left the office as a protection should the stenosis occur during the night. When the victory seemed certain bronchopneumonia intervened with a fatal issue. The microscope negatived the possibility of diphtheria. The persistency of the dyspnea, fixed in its degree, and the absence of paroxysmal attacks of impending suffocation, strongly suggested chronic hypertrophic laryngitis as the cause of the trouble.

CASE 3.—Clarence F., aged 2 years, came to me wearing a tracheal cannula. For several months futile attempts had been made to remove the cannula. The little patient then came under my care at the Hotel Dieu. On enlarging the wound of the trachea a distinct infiltration was disclosed in the subglottic region. I at once introduced a hard rubber gold-lined No. 2 intubation tube (O'Dwyer) securing permanent fixation by means of a silver pin screwed into the anterior surface of the tube itself. The tracheal wound was closed above and below the pin. The fit seemed perfect and the child breathed through the tube without difficulty. This tube was not disturbed until after four months. Its removal showed that considerable dilatation had been effected, but it was not sufficient for normal respiration. A larger tube, a No. 4, with the silver pin contrivance, was placed in position. Baby Clarence was frequently overfed. Though on a liquid diet the vomiting of curdled milk with particles entering the tube caused several attacks of bronchopneumonia. He always tided over these accidents. But here again when just in sight of victory a night nurse overfed him and while in a supine position he vomited curdled milk. The tube was suddenly occluded and Clarence died before the intern could render assistance. The history and the inspection of the parts through the tracheotomy wound pointed to undoubted infiltration in the subglottic area and in the upper limits of the trachea just above the cricoid.

CASE 4.—Robert H., aged 3, was referred by Dr. J. W. K. Shaw, of New Iberia, La. Suprasternal and diaphragmatic tirage called for mechanical help. The insertion of a No. 2 tube (Farroud) immediately relieved the dyspnea. It required one month to overcome the stenosis. About ten extubations and reintubations were practiced before obtaining the final results. After extubations the patient would sometimes breathe perfectly for several hours, after which the progressive but certain return of the stenosis made reintubation imperative. The negative microscopic findings as to diphtheria, the slow onset and the very gradual increase in the dyspnea after extubations, the absence of those rapidly induced paroxysms of threatening asphyxia, seemed to argue that here again was a case of hypertrophic laryngitis.

CASE 5.—(Reported by Dr. J. G. Hirsch, intern, Charity Hospital, New Orleans.) J. R., white, male, aged 1 year, was referred to the Charity Hospital for laryngeal diphtheria, with impending asphyxia. Intubation was done successfully by house surgeon Danna. Cultures were negative. On admission 2,000 units of antidiphtheria serum were given. Three days after insertion of the tube auto-extubation occurred. He was reintubated and 2,000 units of serum were given. Two days after last intubation another auto-extubation occurred which required reinsertion of the tube within an hour. Ten thousand units of serum were administered. The third auto-extubation happened in twenty-four hours and the tube had to be reinserted. Six thousand units of serum were injected. The tube was coughed up within forty-eight hours, but it was swallowed by the patient and was passed two days after by rectum. Tracheotomy was performed by assistant surgeon Stafford and the cannula was removed after ten days. The patient seemed to be improving when a return of the dyspnea on the fourth day necessitated a second tracheotomy which was done by assistant surgeon Cole. Bronchopneumonia followed. Dr. Dupuy was called in consultation. He reintubated with a special metal tube with a low retaining swell. The tracheotomy wound was allowed to close. The tube was not coughed up during a period of three weeks. It was removed several times for cleansing purposes and to test the degree of dilatation in the respiratory tract. After final removal of the tube the child was kept under observation for some weeks, and as it breathed perfectly well was discharged cured.

Comment: Uninfluenced by a large dosage of antitoxin and cultures negative, this case appeared to be one of hypertrophic laryngitis. The tracheal cannula was abandoned as it did not promise to overcome the actual stenosis.

CONCLUSIONS

1. An affection presenting the distinctive features of exudative inflammatory changes with a narrowing of the respiratory lumen in the subglottic and upper tracheal areas, in most instances is the essential cause of persistent laryngeal stenosis in children. This is what we consider as a pathologic entity in itself and the term hypertrophic laryngitis expresses its chief feature. It must, however, be considered as an end-result of some active inflammatory process, which may be of diphtheritic origin. But some other cause non-diphtheritic in character may also prove the essential factor.

2. In children prolonged intubation with a special tube (one with a low retaining swell), using the largest tube possible for the age of the subject, offers in the present stage of our knowledge the best prospects of success in overcoming the stenosis

3. If repeated and dangerous auto-extubations occur, in spite of the use of the special tubes, the fixed intubation tube, made of hard rubber and gold-lined, offers the best safeguard.

4. This hard rubber tube for prolonged intubation is preferable for the reason that incrustations do not occur around the tube and the possibility of ulcerations of the parts, due to contact, is minimized.

5. Tracheotomy not only fails to effect mechanical dilatation in the constricted areas, but it actually invites tracheal cicatricial changes and deformities which will only complicate matters and drive us from Scylla to Charybdis.

ABSTRACT OF DISCUSSION

DR. H. L. LYNAH, New York: I have had experience with these cases covering a period of eight years, and I read a paper on the subject last year and one again this year. The different types I classified as follows: First, the type in which there is a nervous spasm before the tube is removed from the larynx, holding the tube as in a vise, and making extubation extremely difficult; when the tube is finally removed there is a violent spasm and immediate intubation is necessary. Second, the spasm type without nervous element. This is due to the long-continued wearing of the tube, the tube virtually acting as a splint to the intralaryngeal muscles, holding them in a state of fixation or functional disuse The abductors being

held apart so long a time, the balance of power is exerted by the opposing set of muscles, which promotes adductor spasm. Third, the polypoid type, which occurs at the base of the epiglottis and ventricular bands. These polypoid outgrowths fall together as the tube is removed and immediate reintubation is necessary. This type simulates the spasm type. In these three classes the dyspnea is inspiratory, but can be overcome by general anesthesia, only to return when the patient awakens. Fourth, the hypertrophic subglottis type. In this the stenosis is slow and gradual, accompanied by both inspiratory and expiratory dyspnea, and sooner or later intubation is necessary. This contraction usually occurs at the cricoid level, but may involve the entire lumen of the larynx. Fifth, the cicatrix type, due to traumatic or surgical interference. To add a cicatrix to the already complex pathology is most certainly not the proper procedure in the treatment of these cases, and laryngotomy or tracheotomy should not be performed, for the scar when contracting may pull one vocal cord below the other, and the voice may be lost from failure of approximation of the cords. Lastly, the atrophic type, which occurs in cases treated by prolonged dilatation and in which thick sticky mucocrusty masses obstruct the larynx. Here intralaryngeal medication is of benefit, but is of no use in the treatment of the other types. The primary cause in these cases is the severity of the diphtheritic lesion, which prolongs intubation, and this, in turn, produces ulceration, necrosis and sloughing of the cartilage. The firm cartilaginous larynx at the cricoid is now converted into a collapsible tube. Now Nature endeavors to regenerate these areas with fibrous connective tissue, and the cartilage is replaced by new bone formation with projections into the lumen of the larynx. The recurrent laryngeal nerves in these cases are absolutely normal; there is no paralysis of the vocal cords. Dilatation, not laryngotomy, is the only proper treatment for these cases of chronic laryngeal stenosis.

DR. B. R. SHURLY, Detroit: In a long experience, which includes more than 500 intubations for diphtheria, it has been my misfortune to treat seventeen cases of prolonged or retained intubation tubes. We should make a definite classification between prolonged and retained tubes. It was not uncommon in the older days, before we had antitoxin, to see prolonged intubation tubes, those that are required perhaps for more than a week. It is customary, of course, to remove them on an average four days after intubation. In these seventeen cases, which were diphtheritic in origin, sixteen patients recovered and one died; the latter was discovered dead by the mother in the morning; she had slept through the night and the tube was found under the bed, so that result was due to carelessness in nursing. The other sixteen recovered by the use of saturated alum applied to the tube. We should classify these cases carefully, and that has been well done by Dr. Lynah. I cannot agree with Dr. Dupuy in not giving consideration to traumatism as a very frequent cause of the prolonged intubation tube. A number of these cases occurred in the days when we used metal tubes, which were certainly followed by injury to the larynx. They were attended with much more danger to the larynx in the way of traumatism. Some of these cases, too, are subjected to the most humiliating lack of skill in passing the intubation tube. It is not surprising, therefore, that we should meet with injured larynges from bad technic and lack of special knowledge and experience which is difficult to obtain at present. There are so few cases now that there are very few experienced operators left in the field. The entire matter revolves around the earliest possible relief when symptoms of stenosis are beginning. The earlier the treatment, the more certain and perfect will be the results.

DR. EMIL MAYER, New York: Dr. O'Dwyer's tubes are as perfect to-day as they were when first presented. Any single change from the O'Dwyer tube, for the conditions for which they were designed, results in the worst effect one can imagine. O'Dwyer himself found occasions in which some other size or shape might be necessary, but that is only in the exceptional case. As Dr. Shurly has said, he had seventeen cases out of 500, thirty-four in a thousand, that required something else besides the ordinary tube. Something had to be devised, and everyone who has made a study of the subject can show tubes of almost all shapes. I have in my possession a tube that is perfectly round except at the head which was used in a case in which the whole interior of the larynx had been taken out. A retaining swell may be made in any position, and I have no doubt that such a swell in the lower part of the tube may be of advantage in some such case as is referred to by Dr. Dupuy. As to the origin of the diseased condition, I think it will be found on careful examination that the condition is diphtheritic in every single instance. There are, of course, other causes of stenosis. I have presented here before this Section the case of a soldier who was in the Spanish-American war, in which a bullet entered the eyebrow, came down through the maxilla, struck the thyroid cartilage and then dropped into the esophagus, passing out through the bowel. He had a hole in his soft palate, which was the first suggestion that stenosis of the larynx might have been caused by the wound. This patient was treated by intubation with ultimate cure. Another cause is posttyphoid perichondritis and another a rhinoscleroma.

DR. HOMER DUPUY, New Orleans: O'Dwyer's tubes certainly answer every indication in acute stenosis of the larynx in children, and we who enjoy the precious heritage of this contribution should not change the diameter and shape of these tubes one iota, but in hypertrophic laryngitis with a subglottic stenosis we have to meet special conditions, and the fixed tubes and those with the low retaining swell seem to offer the best safeguards in averting dangerous auto-extubations; they, moreover, by procuring dilatation, offer the best prospects for a final cure. In adults laryngostomy may be applicable. It is too long and tedious to be applicable in children. I did not touch on the question of bony changes, because my cases did not show, in my opinion, such profound alterations. I believe that it is only after a period of three or four years that a chronic stenosis of the larynx shows these bony end-results; up to the second and third year they should be regarded as purely fibrous infiltrations.

THE DILATATION OF BRONCHIAL STRICTURES

NOTES ON THE CLINICAL PATHOLOGY OF BRONCHIARCTIA

CHEVALIER JACKSON, M.D.
PITTSBURGH

Bronchial stenoses may be divided into functional and organic. The organic stenoses comprise a number of widely different lesions, but it is only cicatricial stenosis that will be considered in this paper. The chief causes of cicatricial bronchial stenosis are traumatism, syphilis and tuberculosis; or perhaps more accurately, the secondary infections complicating these lesions. Tuberculous processes are of such slow progress, as a rule, that the lung accommodates itself to the altered conditions, and cicatricial bronchial stenoses secondary to tuberculosis rarely require local treatment, though they occur as the result of erosion through the bronchial wall, and I have seen six such cases. Cicatricial stenoses, in some instances, may require dilatation in order to secure proper drainage of the infrastrictural bronchiectatic cavity, and thus cure the patient of bronchiectasis with its distressing cough, foul expectoration, dyspnea and lesser symptoms. For syphilitic strictures it may be necessary to use prolonged intubation with bronchial intubation tubes, put in place with the aid of the bronchoscope and left *in situ* for a period of from one to seven days. The tube should be left for a few hours in case of daily removals, or a few days in case of weekly removals. Extubation is performed with an extubator used through the bronchoscope. In order to obtain a sufficient lumen for the insertion of the intubation tube, a laminaria or tupelo tent may be used, placed *in situ* with my instrument for the purpose. The tent is open to the objection that it obstructs all drainage for the time it is in place, though this need be

for only a few hours. Divulsion, as hereinafter described, is the best method by which to obtain a sufficient lumen for intubation, and even if some trauma results from divulsion, cicatricial tissue is not readily infected by the organisms present, to which the patient is already more or less immune.

In cases of traumatic cicatricial stenoses, such as follows the prolonged sojourn of a foreign body in a bronchus, I believe the best results for gaining access to the foreign body are obtained with my divulsors (Figs. 1 and 2). For the treatment of the stricture after the removal of the foreign body, if such treatment is ever necessary, these same instruments would probably serve equally well, but of this I cannot speak from experience, because in my cases of cicatricial stenosis following the most prolonged sojourn yet recorded of a foreign body in a bronchus (seven and ten years respectively), the patients entirely and completely recovered from all symptoms, including the septic symptoms and the cough. The expectoration lost its odor and purulent character and then ceased altogether, the patients regaining robust health, so that there was no occasion for after-treatment of the stenosis. In both of these cases, the strictures were firm and rigid and of very small lumen. The following is a brief summary of the history of two cases of bronchial stricture treated by divulsion.

Fig. 1.—Small dilator for bronchoscopic dilatation of bronchial strictures. The dilator is actuated by the author's universal forceps handle.

Fig. 2.—Larger dilating forceps with a channel in each member, so as to furnish a canal when the dilator is closed for insertion.

Fig. 3.—Forceps jaws, curved on the edge.

CASE REPORTS

CASE 1.—B. G., a boy, aged 18, small, frail and undeveloped for his age, gave a history of pneumonia eight years before (1903), followed by pleurisy and empyema, which one year later (1904) was tapped and drained. Only a very small amount of pus was obtained and drainage during three months was very unsatisfactory. Temporary improvements were followed by relapses. Chills were attributed to a supposed malarial infection while living in Virginia. One of the most eminent internists in the United States diagnosticated pulmonary tuberculosis, since which time treatment has been chiefly climatic, by residence in Arizona. The boy never regained his health sufficiently to dispense with a nurse. He was frail, under-sized and pigeon-breasted. He suffered continually from cough, usually with purulent sputum, frequently pink-stained, and occasionally of foul odor. He had low, irregular temperature elevation very suggestive of tuberculosis, but sputum examination was always negative.

Report of Physical Examination (by Dr. James I. Edgerton and Dr. John W. Boyce.)—Patient is underweight, pigeon-breasted, and has marked dextrocardia; apices free from disease. Physical signs are confined to base of right lung. Low down posteriorly, and extending to edges of lung, both breath and voice sounds were increased with a suggestion of amphoric breathing and whispered pectoriloquy. No change in percussion note. We are unable to demonstrate either tympany, cracked-pot note or Wintrich's change of tone when mouth is open.

Such was the history and condition of the patient when taken to Dr. James I. Edgerton of New York. Unlike his predecessors, Dr. Edgerton did not conclude that all the physical signs were attributable to the secondary changes, following the supposed empyema of eight years before, and sought the aid of Dr. Lewis Gregory Cole, of New York City, who located with wonderful accuracy by radiographic triangulation, a portion of a lead collar button midway between the angle of the scapula and the spine, 2½ inches from the posterior wall of the chest. The collar button consisted only of a base and post, without a top, giving the appearance of a rivet as seen in the radiograph (Fig. 6).

Operation.—The parents remembered that the child had "choked" ten years (symptoms eight years) previously on the collar button; and they had reiterated their suspicion that the collar button might be the cause of all the symptoms, and in recent years they had even requested that a radiograph be taken. But the scoffing at lay opinions had silenced them. Dr. Edgerton brought the boy to me and at the Eye and Ear Hospital. I removed the collar button through the mouth by bronchoscopy. The ten years' sojourn had produced some interesting pathology. On passing the bronchoscope through the larynx, a large quantity of very foul, blood-stained pus was continually being coughed up from below. This coughing

Fig. 4.—Radiograph by Dr. Willis F. Manges, showing price-tag fastener which had been in the right bronchus seven years. Removed through the mouth by bronchoscopy after bronchoscopic dilatation of the bronchial stricture.

could, of course, have been stopped by deep general anesthesia, but the cough reflex was preserved under slight ether anesthesia as an invaluable aid in ridding the lower air passages of the foul secretion, which obscured everything. Swabs on long carriers were introduced and passed through and beyond the distal end of the bronchoscope. Then when the cough had filled the lower 2 inches (approximately) of the bronchoscopic lumen with secretion, the swab was drawn into the bronchoscope and thus the thick fluids were drawn out by positive lift, as an ordinary water-pump acts on the water that is above the plunger. After the fluid was removed from the trachea in this way, it was easy to see that the pus was coming from the right bronchus. This tube was pumped out and then it could be seen that almost all the right bronchus was a bronchiectatic cavity with a cicatricial bottom, at the right edge of which was a small strictural opening, about 2 mm. in diameter. A cicatricial web occluded about two-thirds of the bronchial lumen just above the stricture and this web at its right end curved downward forming part of the edge of the stricture. The apertures of the upper and middle lobe bronchi seemed more than usually oval in outline, though of this it was difficult to be certain, and the time could not be spared for careful examination, since it was practically certain that the collar button was below the stricture, which therefore must be dilated. The dilator (Fig. 1) was passed and readily entered the lumen of the stricture. The divulsion to

the full extent of the forceps (1 cm.) did not require great force. After the withdrawal of the small dilator, the large dilator (Fig. 2) was introduced and expanded and allowed to remain *in situ* for a few minutes. Next, the cavity below the stricture was wiped out with small bronchoscopic swabs. Basing his judgment on the fact that the physical signs as above given were below the point at which Dr. Cole located the foreign body, Dr. Boyce advised me that the collar button would be found at the top and not the bottom of the abscess cavity. Acting on this advice, a small patch of granulation tissue was found immediately under the overhanging left edge of the dilated strictural opening. During exploration of this granulation tissue with the jaws of the forceps (Fig. 3) the collar button was felt and removed. At the first attempt, the tip of the post of the button came away, permitting the removal of the balance of the button (Fig. 7) edgewise. The boy returned to his home a few days later, and four months afterward, entered college in perfect health, free from cough and expectoration or any remnant of the old condition. One year after the operation, he was sound, healthy and normal in every way.

CASE 2.—Mary N., aged 23, was seen in consultation with Drs. J. Solis Cohen, D. Braden Kyle and Tello d'Apery. The patient gave a history of continual cough and foul yellowish expectoration for about a year and a half, during which time she had an irregular temperature elevation and had lost weight. For seven years she had been subject to severe cough with expectoration during the winter, these symptoms disappearing in summer. The diagnosis of pulmonary tuberculosis had been made by a number of physicians. The foregoing is in brief the history she gave on admission to Jefferson College Hospital.

Fig. 5.—Price-tag fastener lodged for seven years in a lung of a girl aged 23 years. Removed bronchoscopically through the mouth after dilatation of the overlying bronchial stricture. Only one branch wire shows, because the two were in line.

Radiographic Examination.—Dr. Solis Cohen in consultation with Dr. d'Apery found both apices free from disease. The only abnormal physical signs were slight impairment of resonance at the right base, with diminished voice and breath sounds. As these, in his opinion, did not sufficiently account for the symptoms, he referred the case to Dr. Willis F. Manges for radiographic study. Dr. Manges in a beautiful stereoscopic radiograph (Fig. 4) showed a stricture of the right bronchus, with a metallic body resembling an upholsterer's tack, point upward below the stricture and behind the bronchus. The patient remembered having "swallowed" a price tag fastener seven years before, but as she was told that it would pass harmlessly, she had forgotten the occurrence. She had had no symptoms whatever until the following winter.

Bronchoscopy.—At Jefferson College Hospital I passed a bronchoscope through the mouth. The trachea was full of foul purulent secretion which was removed in the same way as in the preceding case, the patient being kept only partially under ether to gain the aid of the cough reflex. The last of the secretion removed from the right bronchus was mixed with blood. The right main bronchus, just below the orifice of the middle lobe bronchus, was occluded by a firm stricture, the lumen of which was a mere slit, extending about 3 mm. laterally, and with no appreciable anteroposterior diameter, the anterior and posterior edges being in contact. At each coughing effort, bloody secretion was forced through the slit. The stricture was dilated by the instruments described in the foregoing case in the direction of the narrowest diameter. Then the source of the bleeding and the blood-stained secretion was found to be a mass of granulations below the stricture and posteriorly. Below this was a large cavity from which a quantity of very thick pus was removed. This pus was not foul like the tracheal pus. On exploration, the mass of granulation tissue at the top of the cavity posteriorly was found to protrude from an accessory cavity, extending posteriorly and medianward, outside of the bronchus. On removal of the granulation tissue, the foreign body was found and removed. It proved to be a price tag fastener (Fig. 5).

Pathologist's Report.—The granulation tissue removed was examined by Dr. Ernest W. Willetts, who reported as follows: "Pathologic Report of Granulation Tissue: Specimen consisted of several very small pieces of tissue. Microscopic examination shows tissue with covering of stratified squamous epithelium which has normal appearance but is thickened considerably at some points. Beneath the epithelium there was a mass of connective tissue showing many mast-cells, fibroblasts, new blood-vessels and some older more fibrous areas. There is also considerable round-cell infiltration. The process appears to be a chronic inflammatory one, the exact nature of which is not evident from microscopic examination."

Subsequent History.—The patient made an entire and complete recovery, and now, one year afterward, Dr. d'Apery reports that she is working at her occupation in the stocking-factory, in possession of perfect health, the cough and expectoration having been totally absent for the past winter, the first out of seven winters.

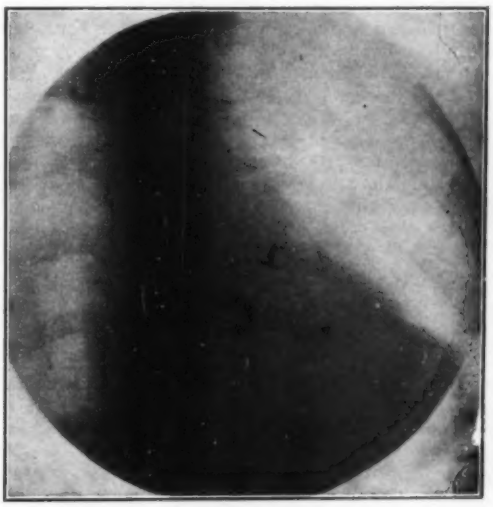

Fig. 6.—Radiograph by Dr. Lewis Gregory Cole, showing lead collar-button (minus head) in right lung of a boy of 18 years. Removed bronchoscopically through the mouth, after divulsion of the overlying stricture.

In view of the fact that almost all cases of unremoved foreign body in the lung are fatal within two years, the prolonged resistance of these two patients to the impaired pulmonary function, and especially to the secondary septic process (for eight and ten years respectively) is remarkable. This resistance in the case of the boy may be partially accounted for by the open-air climatic treatment in Arizona. These two cases being of the longest in duration yet recorded, afford interesting data on the clinical pathology of bronchiarctia. Autoptical pathology is entirely wanting in my personal experience, so that all I can offer is the clinical and the living pathology based on bronchoscopic appearances and the examination of granulation tissue removed. From these and the accepted fundamental pathology of the text-books, the following is formulated: Doubtless very minute bodies become encysted or invade the interlobular connective tissue, as in anthracosis, but aspirated foreign bodies of larger size apparently rarely, if ever,

become encysted, though as in one of the foregoing cases the foreign body may migrate and become somewhat "pocketed."

It is evident from these two, and other, cases, that the foreign body by gravity, as well as by aspiration, reaches the smallest bronchus it can enter, where it stops. Later negative pressure draws it still further downward. By mechanical irritation alone, or, more likely, from this combined with pyogenic organisms carried down with the foreign body there results a productive inflammation which first completely occludes the involved bronchus with swollen mucosa (plus the bulk of the foreign body itself) ending in abscess of the lung below the foreign body. Later, sloughing or ulceration follows in the tissues surrounding the foreign body, permitting the slow escape of discharges, which because of the lessened expulsive cough effort from below consequent on the obstruction, tend to accumulate producing the condition of bronchiectasis above the obstruction. In time, the obstruction owing to the productive inflammation becomes a cicatricial stricture. Below the stricture, the abscess cavity becomes, in a sense, a bronchiectatic cavity, also. The loss of the cilia and even of the epithelium itself follows, as well as increases, the stagnation of the secretions. The law of gravity would lead one to expect to find the foreign body at the bottom of the cavity in the formation of which it has been the chief etiologic factor. The following seems a plausible explanation: The abscess, of course, forms below the obstruction, but by the time the substrictural bronchiectatic cavity has been produced the foreign body has become sufficiently

Fig. 7.—Portion of lead collar-button (used by laundries) removed by bronchoscopy, through the mouth, from the lung of a boy aged 18 years.

fixed by organization of a part of the surrounding cicatricial tissue to hold the body in its place at the top of the cavity which it has caused. The development of a stricture above the foreign body is plausibly explained by the ulceration which is more or less annular. Such ulceration in any channel or tube in the body always results in more or less constriction of the lumen when the scar tissue contracts. That it does not occur to the same extent immediately below the foreign body is probably due to the conditions which cause the substrictural bronchiectasis.

The recovery of both these patients after the removal of the foreign body indicates that the stretching of the stricture improved the drainage of the cavity above as well as that below the stricture, to so great an extent that Nature made a very efficient repair of the bronchiectases. Of course, it is not known how frequently foreign bodies may be the cause of bronchiectasis, but the similarity of the symptoms in bronchiectasis and in foreign bodies in the bronchi, would certainly render exploratory bronchoscopy advisable even in a case with negative radiograph. The close parallel between the symptoms noted in these two cases, as well as in others, and in pulmonary tuberculosis, would seem to render it advisable to suspect the presence of a foreign body in every case of seeming tuberculosis, in which no bacilli are found in a purulent sputum, and especially if the symptoms are confined to the lower lobe, particularly the right lower lobe. This would still leave out the cases of foreign body in which a tuberculous infection has preceded, or, more often followed the aspiration of a foreign body. The use of the radiograph as a routine procedure would certainly seem indicated in the diagnosis of thoracic disease. The erroneous diagnosis of pleural disease in these and other cases of foreign body in the lung has been ably pointed out by Dr. Boyce.[1]

Dr. E. Fletcher Ingals has reported a case in which he diagnosticated a foreign body in a patient previously tapped for supposed pleural effusion.

The location of the foreign body at the top, instead of the bottom of the abscess cavity, is a point of greatest importance, as without the advice of Dr. Boyce on this point, the search in both of the foregoing cases would have been prolonged, and might have been futile, because the foreign body was not in either instance free in the cavity, but, on the contrary, was fixed and bedded in granulation and fibrous tissue, external to the bronchial wall, through which it had eroded its way. The finding of the foreign body would have been difficult, if not impossible, without dilatation of the stricture above them. No useful forceps could have been inserted through the strictures, and the foreign body could not have been found and certainly could not have been withdrawn. If withdrawal were possible, trauma would have been extensive, and probably fatal. The dilatation of the purely cicatricial tissue of the stricture was harmless. Further, and very important, the dilatation improved drainage, so that Nature could care for the lesions resulting from the long sojourn of the intruder. A period of a year has now elapsed and able clinicians pronounce the patients well.

Prolonged dilatation of the stricture after the removal of the foreign body evidently should be deferred until such after-dilatation is indicated by absence of improvement in symptoms, physical signs, and radiographic signs after a number of months.

The method of dilatation by divulsion devised by me and used in these cases possesses the following advantages:

1. It is safe because it is under the guidance of the eye and the trained touch, by which both the direction and the extent of the dilatation are accurately limited at will.

2. It does not require tracheotomy in any case.

3. There is no danger of pushing the foreign body downward as is possible in certain cases, if anything in the shape of a bougie were to be used. Pushing a foreign body downward not only makes removal more difficult but involves serious risk of rupturing the bronchus.

4. It is, obviously, better adapted than tent dilatation or prolonged intubation to foreign body cases, and is, in any case, much safer and simpler.

In view of the foregoing, I feel justified in urging divulsion in the treatment of bronchiarctia.

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ABSTRACT OF DISCUSSION

DR. EMIL MAYER, New York: Dr. Jackson referred to a case that occurred recently in the wards of the Mt. Sinai Hospital; the patient had bronchitis and for general reasons only a bronchoscopy was asked for by Dr. Yankauer and was permitted. A quantity of secretion of a nasty offensive character was pumped out, and finally a foreign body was found; a piece of chicken-bone was removed from the bronchus. The patient had no recollection of having inhaled it. The patient had improved and the result would no doubt be perfect. My most interesting case I reported at the American Laryngo-

1. Foreign Bodies in the Lungs Simulating Pleural Effusion, Med. Rec., New York, Oct. 14, 1911.

logical Association. The child had a most peculiar crowing respiration; physical signs showed absolute obstruction at the lower portion of the right lung, without any previous history of any trouble. No foreign body could be seen; it was thought to be present, however, although *x*-ray examination did not disclose it. Bronchoscopy was done and a tumor was found which filled the lower portion of the bronchial tube. Its removal completely restored health.

THE SUBMUCOUS RESECTION OF DEFLECTIONS OF THE NASAL SEPTUM

THE AUTHOR'S PRESENT PERFECTED METHOD *

OTTO T. FREER, M.D.
CHICAGO

This article describes my way of performing submucous resection of the septum in its now perfected state.

ANATOMY OF DEFLECTIONS OF NASAL SEPTUM

Traumatic Deflections.—These are commonly confined to the cartilage in the form of a sharp, usually vertical, but sometimes more or less horizontal angle at the front

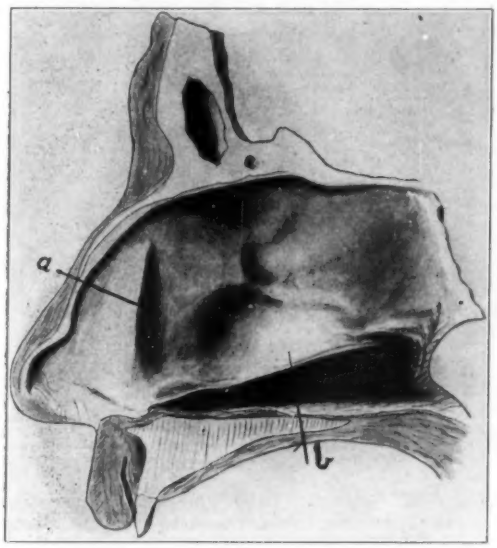

Fig. 3. Side view of the nasal septum, showing a typical double angled deflection with a, the vertical angle, and b, the ascending crest deflection. From a specimen.

of the septum (Fig. 1, Fig. 2, a, b, c, d, i), whose anterior plane lies obliquely or directly across the nostril, or may curve forward. The apex of the angle is the line of the usually ununited fragments, each in its own perichondrial envelope. They often overlap, forming, instead of a pronounced angle, an irregular thickening of the foremost part of the septum (Fig. 2, d, e, f, g, h, j).

The false direction given the growth of the septal cartilage by a fracture may augment a primarily moderate deflection and even involve portions of the bone.

The Osseocartilaginous, Horizontal Crest Deflection from Disproportionate Growth of the Septum.—A septum growing too fast in a normal nasal cavity or normally in a contracted one, not finding room for its expansion, escapes the chronic pressure due to its proportionate excess of growth by buckling horizontally or vertically. The horizontal compression creates a vertical bowing or angle in the septal cartilage (Fig. 3, a).

The vertical pressure takes place between the unyielding hard palate and base of the skull, the result being the familiar horizontal crest deflection forming a sharp angle or crest ascending obliquely from the nasal floor along the anterior border of the vomer toward the sphenoid body in the naris of the convexity of the deflection (Fig. 3), with a corresponding groove in the naris of the concavity (Fig. 4). The vertical pressure which creates this deflection bends over the bony base of the septum formed by the incisor crest and the vomer resting on the superior maxillary and palatine crests, until it arches over the nasal floor, and so makes the grooved articular surface on the incisor crest and anterior border of the vomer, which normally looks upward, look sideways. The pressure also makes the cartilage descend on and overlap the vomer, the cartilage carrying the entire vomero-cartilaginous articulation down with it and pushing before its advancing lower border that flange of the vomeral articular groove which comes lowermost and which hypertrophies into the well-known crest of bone with cartilage so often sawed away (Fig. 6, B, cr).

The arrangement of the periosteum and perichondrium in the crest deflection is also important and was

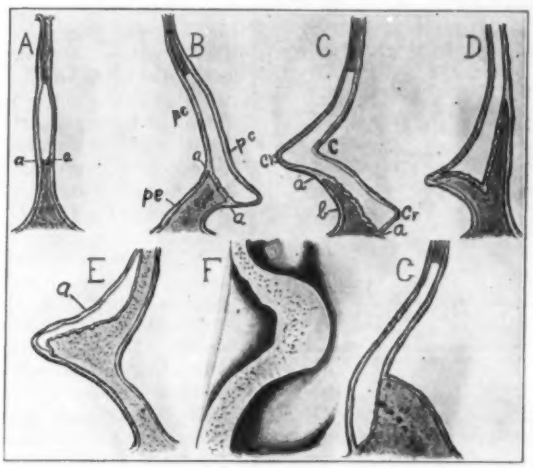

Fig. 6. Vertical sections through the septum. A, normal septum, a—a, vomerocartilaginous joint with crossing of conjoined periosteum and perichondrium from naris to naris; B, typical crest deflection with crossing of periosteo-perichondrium in tilted vomero-cartilaginous joint, a—a; pc, perichondrium; pe, periosteum; C, crest deflection with tilting of the vomerocartilaginous joint into naris of concavity; c, concavity; cr, cr, cartilaginous crest in both nares; a—a, articulation; b, vomer. The cartilage is shown bent on itself in the form of a knee in a manner typical of this type of deflection. D, rare case, cartilage resting in crotch formed by hypertrophied flanges of anterior border of vomer. E, the bony V, formed by the junction of the perpendicular plate and vomer and showing, a, cartilaginous strip created by escape of cartilaginous prolongation, normally within the vomero-ethmoidal articulation. F, a massive bony V. G, crest deflection with typical concavity, yet with the other wall of the septum nearly straight because of lack of overhang of the deflected vomer. Dotted line shows position of usual overhang.

first described by me. *(Journal of Ophthalmology and Oto-Laryngology,* 1907.*)* The periosteum, ascending on the vomer from the nasal floor on the side of the convexity, passes over the tilted articular surface under the overlapping cartilage to the top of the vomer whence it descends on the other side of the vomer into the opposite nostril. Similarly, the perichondrium, descending over the cartilage on the side of the convexity, curls around its lower border and, blending with the perios-

* Because of lack of space this article is abbreviated in THE JOURNAL with the omission of most of the illustrations. The complete article appears in the Transactions of the Section and in the author's reprints.

teum under the overlapping cartilage, ascends on the cartilage in the other nostril. The membranous bridge thus passing through the vomero-cartilaginous articulation must be cut through to denude below it (Fig. 6, B, a-a).

The bottom of the groove of the concavity of the crest or horizontal deflection coincides with the upper border of the vomer and the tilted articulation described, while what has become the lower border of the articulation corresponds with the crest of the horizontal angle of the deflection in the naris of the convexity. Between groove and crest lies the hidden articulation (Fig. 6, B, a-a).

The angle formed by the cartilage and bent-over vomer is continued posteriorly and upward by the vomer and perpendicular plate bent out to form a V lying on the side (Fig. 7, Fig. 6, E, F). The formation of the V by these two bones opens the joint between them at the apex of the V and so permits the cartilaginous strip, lying normally within the joint, to grow out from its open side, where it is attached by indentations to the brodened, rough surface of the laterally opened articulation as a thick, long cartilaginous crest (Fig. 7, a, Fig. 6, E, a).

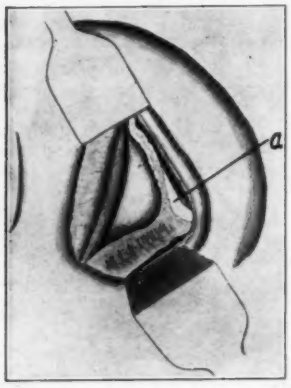

Fig. 7.—Nostril held open with retractors, showing the perpendicular plate and vomer joined to form the bony V; a, strip of cartilage extending backward over opened vomero-ethmoidal joint.

Instead of tilting toward the naris of the convexity the vomero-cartilaginous articulation may tilt toward that of the concavity, the cartilage overlapping the ridge in this naris and producing a deflection having a horizontal crest marking the border of the articulation in each nostril, as shown in Fig. 6, C, cr, cr.

Where only vertical growth compression exists, the horizontal crest deflection just described results. Combined horizontal and vertical compression produce a vertical cartilaginous and a horizontal crest deflection, either both in the same naris or in alternate nares, when they form a horizontally sigmoid deflection.

Where the perpendicular plate of the ethmoid bone bulges into the nostril opposite to the horizontal or crest deflection a vertically sigmoid deflection is formed.

Displacement by growth downward and forward of the free movable part of the septal cartilage, the so-called columnar cartilage, dislocates the free anterior inferior border of the cartilage from its position above the cutaneous septum and causes the columnary cartilage to curl out into one or the other external nostril (Fig. 8). This may be the only existing deviation of the septum or the free border may form the lower border of the anterior plane of a vertical angular cartilaginous deviation, the free border then lying across both nostrils (Fig. 1, a).

STEPS OF THE OPERATION

Position of the Patient.—The patient lies on an operating chair which can be raised and lowered and whose back may be fixed at any desired angle to the seat of the chair (Fig. 9). In all cases, the operator stands beside the patient on the side of the naris in which the operation is conducted. For the final tamponing the patient is placed in an ordinary straight backed chair with the operator sitting in front of him.

Illumination.—The Kirstein head-lamp fitted with the umbrella filament Brünings' miniature lamp.

Anesthesia.—From the tenth year on, in nearly all cases, local anesthesia is employed, a light general narcosis combined with local anesthesia being reserved for younger children to overcome resistance. After clipping the hairs from both nasal vestibules, a small swab is wet with a 1 to 1,000 epinephrin (adrenalin) solution and dipped into pure flake crystals of cocain, the cocain epinephrin mud being then rubbed into the mucosa on both sides of the septum over the area of the operation. In about three minutes the anesthesia is complete. All the mucosa becomes insensible except where it is cutaneous

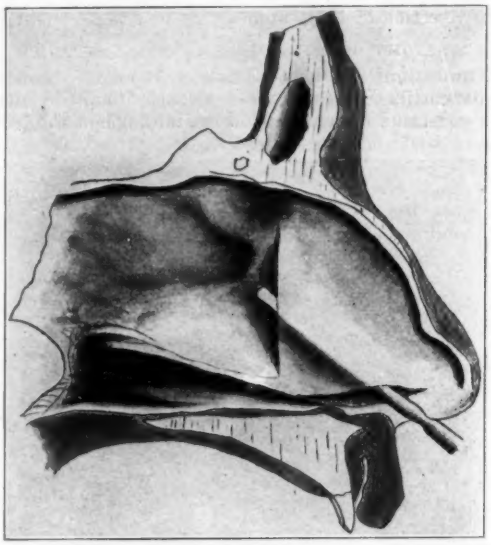

Fig. 12. Convexity of a double angled deflection. The sharp elevator is seen entering through the horizontal incision and cutting out through the mucosa-perichondrium from underneath to make the vertical cut.

in the nasal vestibule. Later, anesthesia is made complete here by rubbing cocain into that part of the incision.

Time Required.—The patient, not understanding that the operation, when properly done, is painless, imagines that the longer it lasts the longer his supposed suffering. Taking advantage of this misconception certain operators make much of the short time in which they claim to do the operation. Gentleness and care take time, while haste means violence, injury and pain. The time required is from one-half hour to two hours, according to conditions. Bleeding from high blood-pressure and especially the results of preceding unsuccessful operations make slow and cautious progress necessary.

Assistants.—Two are needed.

Specula.—In place of a speculum, two narrow, flat retractors held by an assistant hold open the sides of the nostril. A third retractor held by the operator pulls the bottom of the nostril downward (Fig. 10).

Incisions in the Mucous Membrane.—Except in a few horizontally sigmoid deflections, where the operation is begun in the concavity of the anterior bend, the resection is done in the naris of the convexity. Unless peculiar incisions are demanded the operation is begun by the creation on the convexity of the deflection of a flap reflected forward. The first cut (Fig. 11) is made with

the knife D, from behind forward, along the base of the septum where it joins with the nasal floor. In the adult, the cut is begun ¾ to 1¼ inches behind the posterior border of the external nostril and is carried well forward into the cutaneous portion of the septal covering to within ⅜ inch of the anterior border of the nostril. After oozing has stopped, the incision is spread open by having the assistant pull the posterior border of the nostril down with a retractor while the operator lifts the upper lip of the wound with a dull elevator, in order to see whether the perichondrium has been divided. If not, it will be seen as a thick white membrane which is divided with the knife E, enough of it being scraped upward to expose the dead white of the cartilage. From the slit so made, the angular knife Ia or the straight one E is introduced under the perichondrium, dissecting it from the cartilage until dull denudation becomes possible. It is continued as far as the dull elevator can go, upward, backward and downward. Downward it is

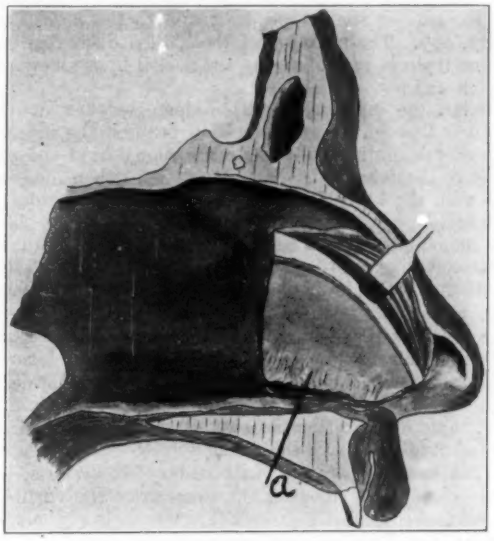

Fig. 13. Side view of convexity of a double angled deflection. The cartilaginous deflection has been excised. The mucosa is shown lying loose and detached behind the vertical cut. The L flap is pulled upward and forward to show the dorsal cut in the cartilage; a, anterior part of vomer and incisor crest, ("the ridge") concealed under the periosteum.

arrested at the apex of the sharp horizontal angle of deflection by the crossing of the periosteum-perichondrium from naris to naris. Here the sharp elevator is used and, cutting around the crest, close to cartilage and bone, it detaches the flap to the nasal floor. Backward, the denudation for the flap is carried as far as may be, passing a vertical angle of deflection with the dull elevator if possible. If not, the sharp one must be used. Denudation around the vertical angle is impossible in some extreme traumatic deflections and here the vertical incision of the L must follow the crest of the angle.

When the denudation for the flap is done, a sharp elevator, I or W, is passed through the horizontal incision under the detached covering to the rear of the denuded area. The blade is then thrust through the mucosa from underneath and, cutting up and down, makes the vertical incision of the L as far back in the naris as possible (Fig. 12). The sharp elevator, thus entering through the horizontal incision and emerging from under the flap through the vertical one continues the vertical cut downward to the nasal floor and releases the flap by cutting free its corner. The flap is now reflected *forward and upward*, until it can be caught and held by the assistant's retractor in the external nostril.

Next, beginning at the posterior edge of the vertical incision, the covering on the posterior part of the deflection behind this incision is uplifted down to the horizontal angle of deflection with the dull elevator, the sharp one then cutting around this angle and to the nasal floor under the periosteum of the vomer. The convexity of the deflection is now bared and the cartilage, uncovered by the reflection of the flap forward, is in plain sight.

The Resection of the Cartilage.—The resection of the cartilage in growth deflections is described here as the typical procedure, the changes from it demanded by the rarer traumatic deflections being noted later. The first incision in the cartilage is made with the round-edged knife E in the line of reflection of the flap and parallel to and as far behind the dorsum of the external nose as sufficient removal of the cartilaginous deflection permits. This incision I call the dorsal cut and the cartilage left under the nasal bridge the dorsal strip (Fig. 13).

In the flap operation the important dorsal cut is made in plain view and is placed just where it is wanted in relation to the nasal bridge, whose under surface it should not approach nearer than ⅜ inch. In contradistinction the tearing, hidden, ill-controlled course of the swivel knife may go dangerously close to the bridge (Fig. 14).

When the anterior inferior free border of the septal cartilage stands normally over the cutaneous septum or

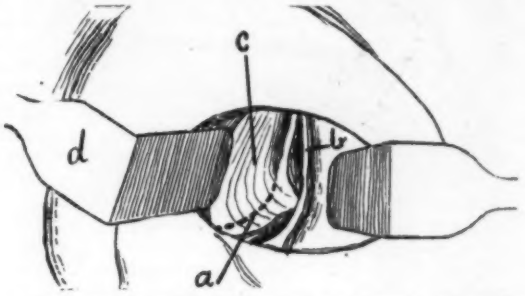

Fig. 17. A.—The ridge (incisor crest and vomer) hidden under its periosteum, which is continuous above with the perichondrium of the opposite naris. Dotted line, a, shows line of cut through periosteum to ridge; b, detached mucosa behind vertical cut; c, mucosa-perichondrium of opposite naris; d, retractor.

curls away into the other naris, the dorsal incision in the cartilage is joined by a horizontal one following the horizontal mucous membrane cut described. If, however, the free border curls into the naris of the operation, the uplifting of the cartilage from its underlying mucosa-perichondrium is begun with the sharp and dull angular elevators Ia and Ib from the free border by dissecting upward from it between the cartilage and the covering of the opposite nostril until the dorsal cut is reached. In the other cases, the uplifting of the cartilage from its attachment to the mucous membrane of the other side is begun either from the dorsal or from the horizontal cartilaginous cut with the small angular knife Ia (Fig. 10). In either case, as soon as a tongue of cartilage is freed, its edge is seized with a mouse-toothed forceps and turned up to show whether a film of perichondrium clings to it, for, if not scraped off, this film leads the elevator away from the cartilage and into and through the mucosa of the opposite nostril.

Behind the anterior adherent portions the dull elevator will usually readily denude the under side of the car-

tilage until it is arrested at the bottom of the groove of the concavity of the horizontal angle of deflection by the crossing of the periosteum from naris to naris as described. To force dull denudation below this crossing creates the commonest type of perforation, along the anterior border of the vomer. The dull elevator should therefore be replaced by a keen one which, entering the vomero-cartilaginous joint, cuts the cartilage from its broad, rough attachment to the side of the vomer and emerges in the naris of the convexity from under the cartilaginous crest, so completing the detachment of the cartilage along its lower border. This overlapping portion of the cartilage is unreachable by the swivel knife, which is arrested by the anterior border of the vomer.

The cartilaginous deflection is next cut away behind by means of the sharp hoe which is passed backward between the cartilage and the detached coverings of the naris of the concavity to the rearmost part of the area of denudation (Fig. 15). Its blade is then turned away from the mucosa and made to cut through the cartilage up and down, severing it from its posterior remnant.

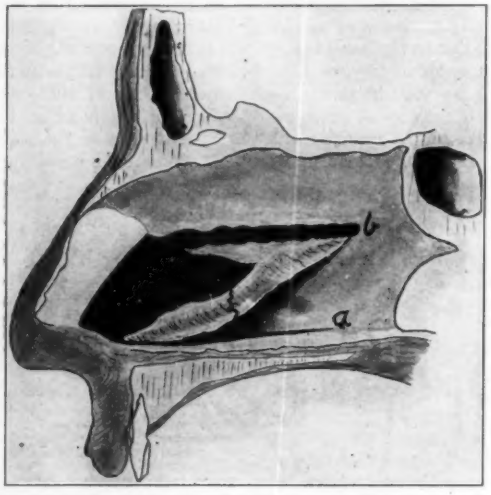

Fig. 19. The undercutting, a, and the overcutting, b, of the ridge and bony V with the chisel below and the punch forceps above.

Its attachment above is then cut through with the sharp elevator and the detached part of the cartilage is pulled out of the nostril. Its remnants are now cut away strip by strip with the hoe and the sharp elevator.

Where, as described, the tilted vomero-cartilaginous articulation slants away from the operator into the naris of the concavity, dull denudation of the cartilage from the covering of that naris may go almost to the nasal floor. In this case, however (Fig. 6, C, b), the vomer lies between the operator and the overlapping cartilage which must be detached from the bone by cutting down over the top of the vomer, the cartilage being dug piecemeal out of its bed between the vomer and the covering of the naris of the concavity.

The Resection of Traumatic Deflections.—Where the anterior plane of the vertical angle of deflection is of difficult access because it lies transversely or curls forward, it is usually best merely to outline the resection in front by the dorsal cut in the cartilage and to detach the cartilage toward it forward from the apex of the vertical angle of deflection and upward from the base of the septum. As the planes of the vertical angle of a traumatic deflection are the commonly ununited fragments of the fracture, each in its own perichondrium, the removal of the anterior fragment or plane leaves no cut edge of cartilage visible behind it to indicate the anterior border of the posterior fragment, which is only found after the perichondrium has been split along it with the knife. Denudation backward with the dull elevator is then usually easy.

The sharp-angled concavity of extreme traumatic deflections is filled by a long tongue of mucosa-perichondrium (Fig. 2, a, b) whose whiteness renders it liable to be mistaken for cartilage and excised with the creation of a large perforation.

When fragments of cartilage overlap, two or even three, lying side by side may have to be dissected out of the thick adherent perichondrium, layer on layer of imbedded cartilage being thus encountered (Fig. 2, e, f, g, h). When the columnar cartilage lies in one or the other of the external nostrils, it may narrow it to a mere slit and yet be hidden from view because closely attached to the side of the incisor crest and to the nasal floor (Fig. 16). The resection of the hidden dislocated cartilage replaces the collapsing slit nostril by a roomy one which will not collapse.

When the columnar cartilage alone is deflected, it is excised through a curved incision through the mucosa-perichondrium made about a centimeter behind and parallel to the free border, the integument, when dissected up with the knife E, being slipped over the border of the cartilage, which pops out of the slit thus made. This incision places the cut out of sight back in the naris. The columnar cartilage is then dissected from its bed while held with forceps, and is cut away with the sharp hoe as high as required. When the dislocation of the columnar cartilage is merely the foremost lowest part of an angular deflection in the same naris, the reversed L flap is used. In the cases in which the free border is dislocated into the nostril opposite to the one containing the angle of deflection, it must usually be dissected out from the latter from the incision just described.

The Resection of the Bony Portion of Deflections.—In the crest deflection, after the removal of the cartilage, there is seen, slanting steeply into the naris of the operation, the broadened, rough articular surface of the vomer, covered by the periosteum which crosses from nostril to nostril (Fig. 17). As it is continuous above with the perichondrium of the opposite nostril, it hides the so-called ridge (incisor crest and anterior part of the vomer) from view.

The denudation of the bony deflection is begun behind in the concavity of the bony V on the perpendicular plate, which is bared of its periosteum with the dull elevator down to the apex of the concavity of the angle formed by the junction of the perpendicular plate and vomer (Fig. 17). From this point forward lies the top of the hidden ridge, discovered by feeling upward on the septum until bony resistance ceases and bagging of the covering of the opposite nostril shows where the top of the ridge is. Along its whole length the periosteum is now split with the knife E (Fig. 17), to the foremost part of the incisor crest (Fig. 17). Downward from this periosteal cut, on the side of the convexity the raspatory now bares the articular surface and also the under surface of the over-arching vomer of periosteum to the rearmost limit of the deflection. The raspatory is then cautiously worked over the top of the ridge and strips the periosteum from its other (concavity) side to the nasal floor in the opposite naris (Fig. 18).

The bony deflection now stands naked and the chisel, applied to the front of the incisor crest, is driven backward on the hard palate underneath the ridge with a dental mallet. To cut closely to the hard palate the bevel of the chisel blade should look upward. If the chisel is stopped by diving, the bevel should be turned downward, when the chisel will rise and again make progress. When the ridge has been undercut to a vertical line drawn through the junction of the perpendicular plate with the vomer, the handle of the chisel is lifted to break off the severed bone at the rearmost part of the cut. Remaining periosteal attachments, made tense by pulling on the loose bone with forceps, are then cut through and the detached ridge is pulled out of the nostril.

The removal of the bony V is next begun by continuing the under cutting of the vomer with the chisel on the hard palate as far back as the deflection goes. The V is then severed above by cutting a path with the punch forceps in the line where the deflected part of the perpendicular plate joins its straight part above (Fig. 19).

If the V, thus detached above and below, now becomes freely movable, it may be safely broken from its posterior attachment with the forceps. If it still remains firm, it is not safe to break it from the strong bone that holds it behind and it should be cut away with the punch forceps (Fig. 16). Bent out portions of the perpendicular plate are now cut out with the punch and the bony resection is completed.

The tilting of the vomero-cartilaginous articulation into the naris of the concavity does not materially change the bony resection from that just described.

The flaps are then smoothed down, and if all of the deflection has been removed, will lie flat, the septum appearing straight on both sides and the posterior pharyngeal wall being visible through the now very roomy naris. The resection of even a moderate deflection produces a surprisingly capacious naris by not only straightening but also thinning the septum.[1]

Perforations.—In my last 200 cases only three perforations occurred, so small that their reporting is merely a matter of conscience.

Protection of the Dorsal Strip by the Flap.—In addition to giving a free operative field, the most important office of the flap is to blanket the cut edge of the cartilage left under the nasal bridge, thus protecting this important buttress during healing and preventing the softening and absorption of cartilage which, as I have observed, spreads to a variable distance beyond an uncovered cut edge of cartilage and might lead to a saddle nose. I have never seen one after an operation by my method in the eleven years which I have practiced it, but know that enough have been created by other operative ways to hurt the esteem of the submucous resection.

15 East Washington Street.

SOME SUGGESTIONS IN THE METHODS OF CORRECTING DEFLECTION OF THE NASAL SEPTUM

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All operative work permits of variation in the technic within certain bounds to accomplish the result desired, according to the ingenuity and individual equation of the operator. No operator should follow a set routine in doing an operation when circumstances in the case or his own predilection demand a modification. It is necessary only to follow the basic principles governing the technic in order to secure a successful issue.

ANESTHESIA

In my early work in this operative procedure, I adopted the prescribed method of inducing anesthesia through the use of cocain. After operating a number of times by inducing local anesthesia, I became impressed with the fact that I was doing justice neither to the patient nor to my sense of nervous equanimity through operating by this method, and resolved to do the subsequent operations under general anesthesia. I have now, for over a period of years, done all of my submucous operations under chloroform narcosis. In producing general anesthesia for this operation it is, of course, essential to have a good anesthetizer, and it is important that the anesthesia be maintained only in a sufficient degree to keep the patient quiet. Every one must admit that this operation is essentially a major one, and, therefore, a hospital procedure. It has always impressed me as remarkable that so few ill results to the welfare of patients have been recorded from the unwisdom of doing this operation in the physician's office and permitting the patient thereafter to go home. Admitting that this operation is a major one, and, therefore, a hospital operation, should it not be done by a method that will give the patient the greatest freedom from shock, the minimum degree of pain, with the greatest degree of comfort and ease of operative procedure on the part of the surgeon? It seems to me that the above-indicated advantages can be more certainly assured under general than under local anesthesia. Shock is greater under local anesthesia in this operation than under general anesthesia in proportion to the nervous susceptibility of the patient. Pain is absolutely annihilated by the general anesthesia; under local anesthesia the operation may or may not be devoid of pain, always in proportion to the amount of bone removed. I find few operators who are unqualifiedly willing to state that they may remove bone by chisel or forceps without giving their patients pain under local anesthesia. Under general anesthesia the surgeon is absolutely at his ease; he is not obliged to divide his time between entertaining or quieting the fears of his patient and the various steps of his operation. He can operate more to the purpose and center his whole attention on the technic of the operation. The fact that the operation can be done in practically half the time — actual operating time — under general anesthesia than under local anesthesia demonstrates the fact that the operator is more at his ease through this method. The only objection that I can conceive to the production of general anesthesia is the agent used and the slight increased annoyance from the bleeding. The ischemia produced under local anesthesia is no doubt more decided than under general anesthesia through the use of the adrenal preparations; nevertheless, the slightly increased bleeding under general anesthesia is almost a negligible quantity, unless there is undue tearing of the flaps. With only the primary incision, without breaking or perforating one or the other flaps, there is only sufficient bleeding to require occasional mopping, never enough to interfere with a good view of the field of operation.

The armamentarium which is required may be reduced to a few instruments, as follows: a Freer right angle retractor; a Ballinger septal knife for making the primary incision; a Killian double-armed separator for raising the mucoperichondrium and periosteum; a Freer sharp separator for work at the cartilago-osseous articula-

1. For the after-treatment, see the complete article.

tions and where adhesions exist; Killian's long nasal specula; Killian's septum forceps; Luc's forceps for cutting through thickened vomer; Ballinger's swivel knife; a V or other type of chisel; mallet, and a pair of nasal forceps. With this simple armamentarium, ingenuity and surgical skill, all cases of submucous resection, however complicated, may be mastered.

THE CHARACTER OF THE PRIMARY INCISION

I uniformly resort to the vertical incision through the mucoperichondrium and the cartilage, extending from as high under the dorsum of the nose as it is possible to go, down to, and extending into, the floor of the nose. The instrument employed for this purpose is the Ballinger septal knife. This incision is uniformly made on the convex surface of the septum, unless conditions in the individual case require it to be made on the concave surface. The incision is made through the cartilage down to the perichondrium on the concave side, the finger being inserted in the concave side as a protector and guide. It is important to make the incision through the tissues throughout its whole course. The incision into the floor of the nose, as suggested by Yankauer, is of great importance, as it permits the placing of the flap on the convex side well against the outer wall of the nose, thus giving a broader field through which the subsequent operative manipulations are to be employed. In those cases in which the free end of the cartilage is bent outward into either nasal cavity, the incision is made directly down on the free presenting border of the cartilage and the dissection is made directly backward from each side of the cartilage. The incision is made, ordinarily, so far forward as to overcome the point of bending. Should a puncture be made in the course of the primary incision through the mucoperichondrium of the concave side, indicated by sensation, or by a drop of blood showing on the protecting finger in the concave side, a perforation is likely to occur at the point of penetration, unless it be guarded against. In order to prevent such a puncture developing into a perforation, after the soft tissues are separated on the convex side, a new incision is made through the cartilage about 3 mm. posterior to the former incision down to the mucoperichondrium of the concave side, and through this new incision the soft tissues are separated on the concave side. There is no operation in which the axiom, "Make haste slowly," is so important as in the submucous operation. The starting of the raising of the flap on both surfaces should be done very cautiously. The operator should exercise due caution at the cartilago-osseous juncture in the separation, remembering that, as demonstrated by Freer, the periosteum and perichondrium are not continuous at these borders.

It is well to bear in mind that any incision which deviates from the vertical incision is apt, except in the hands of the most experienced operator, to leave a greater or less area of gap, which must fill in by granulation, and which enhances the danger of perforation should any accident occur to the other unincised flap. Especially is this true of any form of flap which entails a horizontal incision, such as the various forms of L-shaped flaps. Usually, after performing a perfect operation through the vertical incision, without any injury whatsoever to flaps and with their perfect coaptation, there is practically no crust formation and the case requires no attention at the end of ten days. All operators using the vertical incision, when finding a tear in the lower border of the flap, simulating in result an L-shaped incision, are well aware of the protracted healing, the crust formation and the cicatrix which results when the healing is complete. The nice coaptation of the lower border of the horizontal leg of the L-shaped flap is almost impossible; consequently there is more or less of a gap which must fill in by granulation. The control of the flap during the subsequent phases of the operation and its protection from injury must entail greater embarrassment and care than is required by operating through the simple well made vertical incision.

A great advantage of having the patient under a general, rather than a local, anesthetic is the freedom with which the finger may be used for exploration, if this be desirable. The advantage of this exploration to one who has made use of it in desirable cases is too patent to require argument. Well-bowed septa, which permit no view of the nasal fossa beyond the dome of the convexity, can be perfectly oriented through this method of exploration, establishing the existence or nonexistence of ridges or spurs of the septum beyond the parts subject to visual inspection. The use of the finger is also of value in cautiously forcing over sharp angles and marked convexities of the cartilaginous septum, so that the extreme angle is softened down and the dome of convexities made less pronounced. The cartilage so forced over remains in the altered position only a few moments, but this is usually sufficient time to assure greater ease and safety in surmounting these otherwise difficult passages in the above-mentioned type of septal deformities. I find also that, through the appropriate use of the finger during the operation, the amount of bone removal is reduced to the minimum. Usually I remove the necessary amount of cartilage and chisel away as much of the nasal process and the vomer anteriorly as the circumstances of the case may require. Following this, if the vomer and perpendicular plate are much bowed, a narrow ledge of bone in an anterior posterior direction is removed through the point of greatest deflection as far back as is required. After the completion of this stage of the operation, the Killian speculum is removed, if it has been employed, and the index-finger is inserted between the flaps down to the osseous septum, when slight pressure toward the concave side is employed by the end of the finger on the lower bony ridge first until it fractures and then on the upper until it fractures; a little molding will then place the osseous septum in a perfectly vertical position. When this procedure can be adopted, it not only materially lessens the amount of bone removed, but also lessens the actual time required in making the operation. Even after the removal of pronounced ridges or spurs, in the osseous portion of the septum, the bone above and below will often be found out of its normal vertical plane. These are ideal for finger correction, as a little pressure will snap them over into the vertical plane. These suggestions are not new, but, if they prove of practical utility to some of my hearers, I would feel repaid.

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SUBMUCOUS RESECTION OF THE NASAL SEPTUM

INDICATIONS AND CONTRA-INDICATIONS

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The operation known as submucous resection of the nasal septum has been in general use for about eight years. During that time, it has become an important part of the rhinologist's work, and it seems almost grat-

uitous to offer any additional words on its indications and contra-indications. And yet, on the other hand, the greater experience and opportunity for observation afforded by the multitude of cases make a definite statement of much greater possibility than heretofore. For this reason, the invitation to take part in the symposium on submucous resection was accepted.

INDICATIONS

There is little argument as to the indications. While some rhinologists still cling to older forms of operation, the vast majority are more and more limiting themselves to the submucous resection. And with the coming of the younger generation, there is a still greater tendency to ignore the older forms of operation. What is more logical than the removal of an offending deflection after elevating the mucosa on both sides? How much better than to saw it off, to smash it, to cut it cross-wise, to use any of the cartilage flap operations, and then put in a retaining splint for a longer or shorter period! Certainly the millennium for nasal surgery is almost at hand when such operations can be done speedily and safely and with so little discomfort to the patient.

In considering the indications, it is first necessary to study the deflection itself. The varieties have been classified in various ways, as to position, character and amount. While these are important from a pathologic standpoint, they are not so essential in determining the indications. For our purposes it will be sufficient to group the deflections as to degree as follows: (1) slight, (2) marked, (3) extreme.

While there is no hard-and-fast line of division between these, the designations are sufficiently clear for the purposes outlined. The term deflection is here used generically to include deviations, spurs and ridges.

1. *Slight Deflections.*—These vary from the minutest degree to that which of itself cannot materially act as an obstruction to nasal drainage or respiration.

2. *Marked Deflections.*—In this group there is always some interference with nasal respiration or drainage.

3. *Extreme Deflections.*—This division comprises those deflections which cause a continuous and excessive obstruction to nasal respiration or drainage. What would be a marked deflection if confined to one side becomes an extreme deflection if the other side is also affected.

These groups having been thus defined, the indications may be outlined as follows:

Recurrent Acute Inflammations of the Nose.—Slight deflections rarely exercise an etiologic influence in this disease, though marked and extreme deflections often do.

Acute Inflammation of the Accessory Sinuses.—Removal is indicated for any deflection of the second and third degrees, as the interference with nasal drainage is one of the marked predisposing causes. There is even some justification in operating on a slight deflection if other means have been tried without avail.

Hypertrophic Rhinitis, Chronic Rhinitis of Various Forms.—Whether or not operation is contemplated on the turbinates, deviations of the second and third degree are to be corrected. Operation on slight deflections is not indicated.

Atrophic Rhinitis.—It is always a matter of some doubt whether septal operations are of any value in atrophic rhinitis of long standing. At any rate, little can be expected from operation on any but extreme deflections. In early cases improvement may follow operations on marked deflections especially where drainage is subjected to material interference.

Chronic Inflammation of the Accessory Sinuses and Nasal Polypi.—Marked and extreme deflections are to be corrected and even slight deflections when they interfere with proper treatment or drainage of the sinus.

Hay Fever.—Experience has shown that while a septal operation has no curative influence on this condition, it generally assists in alleviating the symptoms.

Diseases of the Pharynx, Larynx, Trachea and Bronchi.—Whenever there is nasal respiratory insufficiency causing mouth-breathing, its cause should be removed and hence deflections of marked or extreme degree are to be corrected.

Middle-Ear Affections.—Marked and extreme deflections are to be corrected in view of their influence in causing and increasing affections of the middle ear. Removal of a slight deflection may be called for especially when it is so located that some change in the density or supply of air is occasioned.

CONTRA-INDICATIONS

Nasal operations are subject to very little danger, and an unfavorable issue, so far as the life or health of the patient is concerned, seldom results. This has been ascribed to the fact that the nasal mucus is sterile ordinarily or at least that it is not a good host for bacterial flora.

Besides this, it must be remembered that the drainage after nasal operations is especially good and there are no confined places where pus bacteria may find a favorable nidus for development. This refers more particularly to the ordinary cutting operations. The submucous resection is an operation of a different type, for here we traumatize the osteochondral surfaces of the mucous membrane which have previously not been exposed to the air. When these surfaces are more or less closely approximated, they afford opportunity for the formation of pockets between them in which bacteria may develop. In this situation, too, the danger is greatly increased by the lack of drainage from these pockets. The practice of retaining the plug in the nose for more than twelve hours still further encourages septic invasion.

Serious results have been reported by some observers. Thus Hays[1] had two cases of septicemia, one resulting in death. Horn[2] reports, out of 110 cases, tonsillitis occurring thirteen times, in one of which severe pericarditis and endocarditis resulted, otitis media suppurativa three times, septal abscess twice, perichondritis once.

In my own practice, before I adopted the plan of removing the plug within twelve hours after operation, I had far more cases of tonsillitis following the operation than since. In one case, the septic tonsillitis was accompanied by a nephritis. In another, otitis media suppurativa followed. I am convinced that the danger of infection is materially increased in proportion to the time during which the plug is allowed to remain in the nose.

Naturally, too, the dangers are decreased in proportion to the means taken to operate under the strictest modern surgical technic. Hence operations performed in the office cannot offer as much in this respect as those performed in a hospital.

Correspondingly, the contra-indications are not so potent in the one type as in the other

The following are contra-indications:

1. *Age.*—The very old and the very young are not good subjects for operation. In the first instance it can

1. Hays: Septicemia Following Submucous Resection of the Nasal Septum, Laryngoscope, 1909.
2. Horn: Die Schwierigkeiten und Complicationen der submucösen Operation bei Scheidewanddifformitäten, Ztschr. f. Laryngol., ii.

only be most exceptional for the operation even to be considered and then the short period of life yet before the patient, the greater danger of operation, its decreased value in patients of this type and the fact that it is not a life-saving measure all contribute to make the operation unjustifiable. In the second instance, no harm will result from postponement. There is even a great deal of question as to the advisability of operating on those who are beyond middle life. In most instances, the damage has been done and as a rule no further harm is occasioned by the presence of the deflection. Sometimes growing deafness calls for removal of the obstruction, particularly if it be of the extreme degree, although under these circumstances even one of a marked degree should be removed when its influence is clear. But to remove the obstruction simply for respiratory purposes is indicated but seldom in individuals past middle life.

In children and in young people below the age of 18 there is always great doubt as to the advisability of operation. Even now, experience has been insufficient to establish just what influence the removal of a large portion of the septum in the young has on the development of the nose.

Moreover, Rethi[3] states that the development of the septum has a marked influence on the face in adult life. Lothrop[4] reports that of eight children between 7 and 13 years of age on whom a submucous resection had been performed, the tip of the nose was depressed in five instances. He ascribed the depression not to the insufficient support from too little cartilage but to a retarded growth of the remaining cartilage, while the bony parts develop normally. I refrain from doing a submucous resection in those under 17 or 18 unless it is imperative by reason of associated conditions involving the sinuses or middle ear. Even then I remove as small a portion as is consistent, preferring to postpone the more radical operation until a later period.

2. *Acute Sinus Disease.*—The presence of a suppurating focus close to the seat of operation materially increases the danger and hence the operation should be postponed until the cessation of the active process. In chronic conditions there is far less danger.

3. *Acute Middle-Ear and Pharyngeal Diseases.*—Under these conditions, operation is inadvisable and when there is much tendency to them, great circumspection should be observed.

4. *Syphilis.*—Very naturally, during the active stages all operations not urgently indicated should be postponed. There is, moreover, much danger in operating on the septum in the presence of nasal syphilis in the tertiary stage. I have seen a patient with tertiary syphilis of the nose on whom a submucous resection was performed by a practitioner who failed to note the presence of the disease. Following the operation, there was extensive destruction of the nasal bones, the septum, malar bone, floor of the orbit and palate and the greater part of the superior maxillary. Frequently, a deflection will be the seat of a syphilitic process which may escape the attention of the rhinologist intent on the obstructive condition.

5. *Tuberculosis.*—Tuberculosis of the upper respiratory tract is a contra-indication. Pulmonary tuberculosis is likewise a contra-indication, unless it is probable that the operation on the nose will lessen the symptoms due to the condition of the nose, pharynx, larynx or ear. Even under these circumstances nothing should be done, if it be manifest that the patient has only a short time to live.

6. *Serious General Conditions.*—General conditions, if serious, should deter one from performing the operation, especially chronic inflammations of the kidney, heart, etc., diabetes and most mental affections. Hemophilia, severe anemia and leukemia, carcinoma and other diseases which are likely to terminate in early death are definite contra-indications.

3. Rethi: Ueber Septumoperationen im Jugendlichen Alter, Wiener med. Wchnschr., 1910, No. 47.

4. Lothrop: Observations on the Late Results Obtained by the Submucous Resection of the Nasal Septum, Boston Med. and Surg. Jour., May 12, 1910.

CONCLUSION

In conclusion, it may be stated that, besides the indications and contra-indications enumerated, there is always the personal element to be considered, made up of the technic of operator and his conscientious appreciation of what is best for his patient.

537 North Grand Avenue.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. FREER, RICHARDSON AND LOEB

DR. W. L. BALLENGER, Chicago: As to the swivel knife, I have little to say. If an instrument cannot take care of itself after it has been used by the profession for eight or ten years, I have not the slightest inclination to defend it. As to its being the cause of deformities of the nose, I have no information whatever; perhaps it is because it is used a hundred times more often than any other method. Now, if the swivel knife is used with intelligence, and certainly Freer's instruments require intelligence for their use, I am sure it could never cause sinking in of the nose. It is my practice before operating on the nose to feel the tip and see if there has been previous injury followed by softening; if so, I do not perform any extensive operation on that portion; they are the cases in which there is sinking in. Another kind consists of those followed by infection of the wound and destruction of more or less of the cartilaginous tissue. I do not believe the swivel knife or any other instrument has ever been the direct cause.

Now, as to the use of the finger, as referred to by Dr. Richardson, it has been my practice to use it, and I learn much more in that way than I can with the speculum; you can feel projecting points that otherwise you may overlook.

I have never given general anesthesia but once. I find it easy to introduce my finger into the nose and feel the whole septum without discomfort to the patient under local anesthesia. The safest and best method for the use of cocain is with pledgets of cotton on a probe dipped into the powdered cocain, as suggested by Dr. Freer many years ago.

DR. B. D. SHEEDY, New York: I am much surprised to hear Dr. Richardson say that he employs general anesthesia in this operation. In New York, at both postgraduate schools and at one of the universities, students are instructed not to use general anesthesia in this work on account of the associated difficulties and dangers. Dr. Richardson's remark that he does not know a surgeon who can do this work without pain under cocain shows that his acquaintanceship with the New York men, at least, is limited. I know of many. It is seldom that a week passes during which a frontal sinus or an antrum of Highmore is not opened before the class at the Post-Graduate under local cocain anesthesia, and I have assisted Neumann in Vienna in doing radical mastoid operations under cocain. At the New York Post-Graduate School, as well as at St. Joseph's Hospital, general anesthesia is seldom, if ever, employed. Cocain with epinephrin is generally employed; sometimes cocain in crystals. Occasionally a writer recommends that the tampons be allowed to remain in the nose from twenty-four to forty-eight hours; I saw a recent article in which it was advised that they be kept in thirty-six hours. If one thinks of the amount of secretion that there must be in the upper breathway while these tampons are in position he will appreciate the danger of sinus infection if the tampon

is allowed to remain in for more than twelve hours. The longer the tampon is in the better the chance for sinus infection and tonsil infection.

DR. C. F. WELTY, San Francisco: The remarks I made with reference to the swivel knife are not just exactly as they have been put. I made the statement that "undue force in the use of the swivel knife is liable to tear or break the cartilage from its attachment above and result in saddle nose." A patient that came home after having been operated on in Europe by one of our celebrities had such an experience. Undue force was used, and in three days there was dropping of the nose, which persisted. The biting forceps Dr. Freer speaks of in contradistinction to breaking of the bone is perhaps a very good suggestion. I have always broken the bone, but when it did not break easily I used the punch.

DR. W. W. CARTER, New York: I think Dr. Freer uses too many instruments. I employ only four, a small knife, a speculum, a combination elevator and curet and a punch forceps. The point of this curet-elevator is so directed that when the instrument is held in a straight line the tip always rests against the cartilage. The punch forceps I devised is the first punch forceps used in this procedure, and I am glad to see that it is now being generally conceded that this instrument is the proper one for removing the septum. I saw recently a case, sent to me for bone transplantation, in which there was sinking in of the bridge, due to the removal of the upper edge of the septum where it rests between the lateral cartilage and where it acts as the keystone to the nasal arch. I am surprised to hear Dr. Richardson say that he prefers general anesthesia. I have operated in two cases in this way and found it very difficult.

DR. LOUIS OSTROM, Rock Island, Ill.: I want to enter a protest against all forms of packing after the submucous operation. For the last four years I have operated on a great number of patients without any packing whatever, with better results than I obtained previous to this method. You cannot pack the nose so as to obtain uniform pressure when the reaction produces swelling of the turbinates, and the size of the apertures of the nose absolutely limits packing over the entire operated septal area. Furthermore, removing the packing during the next twelve hours allows hematomas to form, which the packing is supposed to prevent.

After completing the operation I cut or punch several holes into the mucous membrane, so as to allow drainage of blood, etc., from the intraseptal space. Of course, I pack if bleeding takes place to demand it, but in four years I have not needed any packing by my method. Instead of packing I keep the patient perfectly quiet for three or four hours, and I have no hematoma that I would not have with packing. In the course of three or four days the great majority of patients are able to be back at work.

DR. GEORGE L. RICHARDS, Fall River, Mass.: I have happened to see Killian operate lately; he uses no packing and no suture. He simply puts a pledget of cotton over the nose to prevent breathing through it.

DR. G. C. KNEEDLER, Pittsburgh: I make the Ballenger incision and use the swivel knife. After removing as much of the cartilage as possible in one piece, I correct the abnormalities as to thickness and curvature, placing it in a normal salt solution at about 99 F., until the operation is completed, when it is reinserted and the incision closed by two stitches. This procedure I have followed for the past two years without losing the cartilage or a failure to secure union in a single case out of a series of thirty-eight done during that period. By this method I secure a septum which approaches the natural one by making a firmer support to the mucous membrane, and by preventing the possibility of the enlargement of an accidental perforation that might be made during the operation. A portion of the cartilage is also left at the tip of the nose. I have never seen any sinking of the nose.

DR. OTTO T. FREER, Chicago: I do not need general anesthesia for my operation, for the shock and pain which have impelled Dr. Richardson to make general anesthesia a part of his method do not belong to mine. By taking time I can employ the gentleness and patience which avoid these features. Dr. Richardson speaks of the bleeding as slight under general anesthesia. Of course, where the operation is confined to merely cutting out a piece of cartilage with the swivel knife and perhaps breaking over some bone, the bleeding is slight, even when the patient is put to sleep and foregoes the hemostatic effect of cocain-epinephrin anesthesia, but where the real surgery demanded is done and the often massive bony deflection is resected, as it should be, with the cartilage, there may be free temporary bleeding from bone and periosteum, even under local insensibility, not to speak of general narcosis, under which hemorrhage is as unchecked as in the days before cocain.

Dependence on general narcosis necessarily makes the operation a hasty one. The virtues of the flap are, as stated, protection of the strip of cartilage under the nasal bridge, visual access to everything and the avoidance of hematoma and possible resultant abscess. I find neither the crusting nor protracted healing mentioned by Dr. Richardson as pertaining to the flap, which, contracted during the operation, expands by the next day, so that there is linear union of the L wound.

Dr. Richardson speaks of inserting his finger between the flaps to break over bone. It is unsurgical to put a finger in a wound if it can be avoided. A thick bony deflection can seldom be broken over, and where it does break in a thin place, the thick part of the bone, with its projections, is left to obstruct. Bone should be resected, not broken over and left by easily satisfied surgery. Fracturing, unless the bone be overcut and undercut, is liable to send dangerous fissures into the sphenoid sinus, the optic foramen or the cranial cavity. I have had as good results in patients over 70 years of age as in younger patients. I must ascribe the depressed tips of the five children mentioned by Dr. Loeb to the popular Killian method, which is unsuitable for children, and includes the swivel knife, whose dangers, its unguidable, tearing cut, its likelihood of pulling on and breaking the bridge, would be increased in a child's frail nose. In my hundred operations on children I have had perfect results and no deformity.

Text-books have called my operation a modification of Killian's. My first description of my operation was in THE JOURNAL of the American Medical Association in 1902. Killian's first paper appeared in 1904, two years later. My instrumentarium and operation are original throughout, and I was the first to describe the preservation of the mucous membrane, before Hajek, Menzel or Killian.

DR. CHARLES W. RICHARDSON, Washington, D. C.: I believe that in this, as in a good many other important procedures that have been suggested, that, after general anesthesia has been tried and its advantages recognized, a great many will adopt it in this work. I would like to call attention to the fact that there are more deaths being caused by the use of cocain and epinephrin in this operation than can ever be produced through general anesthesia.

The clean finger properly used is necessary in a great deal of operative work. I have never had an infection in septum work. I did not refer to breaking thick bone—I stated distinctly that I cut away the thickened angle of deflection, and, should there be still thin portions of the perpendicular plate or vomer out of the perpendicular above and below the portion of deflection removed, this could be replaced by gently fracturing it over by the pressure of the finger.

The swivel knife is not to be used as a tearing instrument, but as a cutting instrument, and in all the cases in which I have used it on the cartilage, it has cut as perfectly as any instrument could. Guided with good judgment and discretion it can be used as safely as any instrument working back in a cavity. I use a tampon, such as has been referred to by Dr. Freer. Excessive bleeding, either before or after tamponing, means excessive tremor of flaps. With the vertical incision you cannot get much hemorrhage. I never have any hemorrhage in these operations after tamponing or after removal of tampons.

DR. B. D. SHEEDY, New York: I want to say in regard to Dr. Richardson's remark about deaths from cocain in the submucous resection, that there have been no deaths in our city from that operation so far as I know. The deaths that have been reported by rhinologists were in patients in whom cocain and epinephrin had been injected into or around the tonsils.

If Dr. Richardson will refer to my recent article on "The Use of Bisulphate of Quinin as a Local Anesthesia," in the *New York Medical Record*, in which the deaths that had recently occurred were reported, he will find that no deaths from or in connection with this operation were reported.

DR. H. W. LOEB, St. Louis: I have discarded the method of operating in the sitting position which is so tiring. If you operate with a patient in the recumbent position, the danger from cocain is much less; the patients do not faint and the position is much better for the operator.

THE EXPLORATORY NEEDLE PUNCTURE OF THE MAXILLARY ANTRUM IN ONE HUNDRED TUBERCULOUS INDIVIDUALS

DEMONSTRATING THE MARKED DISSIMILARITY BETWEEN THE CLINICAL AND POST-MORTEM FINDINGS

ROSS H. SKILLERN, M.D.
PHILADELPHIA

Ever since I began to pay especial attention to the accessory sinuses of the nose, it seemed to me that the post-mortem findings of several investigators in sinus disease and pulmonary tuberculosis appeared unreconcilable with clinical findings.

Fränkel,[1] in necropsies on forty-five patients who died from pulmonary tuberculosis, found that the sinuses were diseased and that sixteen, or about 35 per cent., contained pathologic secretion.

Harke[2] found inflammatory exudate in one or both of the maxillary antra of twenty-three patients, or 60 per cent., out of thirty-eight who had died from pulmonary phthisis.

Minder[3] discovered four, or about 23 per cent., in seventeen, and Wertheim,[4] thirty-one, or 29 per cent., in 106.

The method employed by these investigators to inspect the sinuses closely adhered to the technic of Harke. This consists in peeling back the scalp in front to the eyes, behind to the foramen magnum, and in sawing a vertical cut which divides the nasal chambers. The two sides are pried apart with heavy chisels, thus laying bare the frontals and sphenoidals and making the ethmoid capsule and maxillaries easily accessible.

Reverting to these post-mortem findings, it will be noted that four pathologists give the proportion of sinus disease in tuberculous individuals as approximately 37 per cent. This would mean that one out of every three phthisical patients had a sinus affection. I had never been able to substantiate these findings in clinical examinations on the patients referred to the laryngologic department at the Rush Hospital for Consumption and, while accepting their possibility, could not do otherwise than look on whatever sinus inflammation might exist as insignificant or at least so latent that no subjective or objective symptoms were ever occasioned. This standpoint, however, was highly unsatisfactory, as it did not prove that inflammation failed to exist because no signs of purulent secretion were present in the nose, nor did it disprove the apparent connection between pulmonary tuberculosis and sinus disease. On this account, three years ago I started an investigation which would demonstrate conclusively the exact proportion of maxillary sinus empyema occurring with consumption. This consisted in making needle punctures of the antra, when permitted, on each tuberculous individual admitted to the hospital, regardless of the nasal symptoms, and in irrigating the cavity with warm normal salt solution. The maxillary sinus was selected because (a) it could be punctured with little or no inconvenience to the patient; (b) it is more frequently diseased than all of the other sinuses, and (c) it requires but a moment and is free from untoward after-effects.

1. Fränkel, E.: Beitrag zur Pathologie und Aetiologie der Nasennebenhöhlenerkrankungen, Virchow's Arch. f. path. Anat., 1896, cxliii.
2. Harke: Beitrag zur Pathologie und Therapie der oberen Athmungswege, Wiesbaden, 1895.
3. Minder: Fünfzig Sektionsbefund der Nase und deren Nebenhöhlen, Arch. f. Laryngol. u. Rhinol., 1902, xii.
4. Wertheim: Beitrag zur Pathologie und Klinik der Erkrankungen der Nasennebenhöhlen, Arch. f. Laryngol. u. Rhinol., 1901, xi.

TECHNIC

Both nasal chambers were thoroughly irrigated with warm normal saline solution until perfectly cleared of all secretion. Cotton carriers saturated with 20 per cent. solution of cocain were introduced beneath the inferior turbinates as high as possible and allowed to remain in place for at least ten minutes. The point of a sterilized Lichtwitz needle was placed in the anesthetized area and with a gentle push penetrated into the antrum. Only in exceptional cases was the slightest force required. Air was now forced into the sinus through the needle in order to ascertain whether the lumen was free and in proper position. The syringe was then filled with the normal salt solution and under slight pressure the liquid was forced into the cavity, the patient holding the head inclined forward in order that the escaping fluid would appear anteriorly and be caught in a clean basin. In this manner the sinus was irrigated and the returning fluid subjected to careful inspection. Both antra were treated in this manner. If pathologic secretion were present even in small quantities it could easily be detected as it presented a cloudy aspect in the basin.

One hundred patients were thus examined, nearly all being in the last stages of consumption, with the following results:

Of the 100 right maxillary sinuses, seventy-two were absolutely normal; fourteen showed considerable blood; in eight returning fluid was turbid, and in four purulent secretion was found.

Of the 100 left maxillary sinuses, eighty-eight were absolutely normal; none showed blood; in seven the returning fluid was turbid, and in three purulent secretion was found.

On the right side, if we accept the blood as a mark of disease, the percentage would be 26, while that of the left side would only be 10, making an average of 18 per cent. If we eliminate those which showed excessive hemorrhage, the proportion would be very much less, totaling only 11 per cent. When one takes into consideration that the bleeding occurred only from the right side and that no pus was apparent either with the naked eye or microscopically (in two cases), it would seem that other factors, such as possible traumatism of the antral mucosa with the needle, might have been more or less responsible. In 7.5 per cent. the returning liquid was turbid, showing that secretion of some sort had been present in the sinuses. We must consider these as diseased. In only seven sinuses, or 3.5 per cent., was purulent secretion present. Considering then that 11 per cent. were proved diseased, why do the post-mortem examinations show such a high percentage (37 per cent.)?

Before attempting to explain this discrepancy let us briefly consider the physiology of the maxillary sinus under normal and pathologic conditions.

Törne,[5] in a series of elaborate experiments, was able to prove that the normal sinuses during life are sterile. By making necropsies as soon as possible after death he showed that it required several hours for bacteria to infect these cavities. In all those cadavers which had not been dead for over two hours the healthy sinuses were sterile while contamination occurred in direct relation to the length of time elapsed since life became extinct. In all bodies microorganisms were present five hours after death. The reason for this normal sterility is explained by his experiments on the heads of freshly slaughtered calves. These heads, while yet warm, were opened in such a manner that the nasal wall of the antrum was fully exposed, yet not soiled with blood. Small particles of lamp-black were placed on different portions of the sinus and observed under a strong reading-glass. They were seen plainly to move continuously in the direction of the ostium and finally to disappear into the nose. The rate of speed equaled about 0.5 cm. per minute. This was, of course, due to the ciliary action of the sinus mucosa. The action became feebler and feebler as cadaveric rigidity became established and finally ceased altogether. This explains the reason for the sterility of the sinuses during life. Even should minute foreign bodies find their way into these cavities, the ciliary action of the mucosa would expel them through the ostium into the nose.

When the mucosa becomes inflamed, even though slightly, the increased hyperemia causes swelling which interferes with the action of the cilia in direct ratio to its volume. Bacterial action in conjunction with this inflammation can destroy large areas of the columnar epithelium and after the cilia are destroyed the character of the tissue often changes from columnar to squamous epithelium. A sinus which has been the seat of a chronic disease would therefore be unable to resist microorganismal invasion to the same extent as one fully supplied with normal ciliated epithelium. During life the cilia prevent the wandering in of microorganisms and should any gain access to the sinus through forcible blowing of the nose or otherwise, they are subsequently expelled unless the mucosa is diseased or injured, in which case it might prove a suitable medium for their growth.

It is this action of the cilia which explains the discrepancies between my clinical findings and those recorded by the pathologists. The antra in those cases in which the fluid returned clear were healthy beyond all shadow of doubt, as they showed no symptoms either previous or subsequent to the needle punctures. In those cases which showed an excess of blood, subsequent puncture in ten of the fourteen brought forth the rejected fluid unchanged. Only those in which the liquid was turbid or contained pus could be unqualifiedly accepted as cases in which pathologic secretion was present in the sinus. As mentioned before, this was 11 per cent., while the post-mortem examinations showed secretion in 37 per cent. Shortly after death the cilia become motionless, yet the glands continue to secrete or at least become relaxed so that whatever secretion was present would appear in the sinus. Specific gravity would also cause the secretion to collect in the most dependent portion. Even were the walls but moist, the collection of this fluid would not be inconsiderable and might readily appear turbid either from chemical changes or from the action of bacteria. In many of these cases the mucosa was reported unchanged. It is even possible that maceration from the contact of the secretion, together with the action of the microorganisms, might cause microscopic changes to appear in the mucosa. Törne[6] found pathologic changes in the antral mucosa of seven (23 per cent.) of thirty individuals who had died from pulmonary tuberculosis. While in all these cases microorganisms were found in the fluid within the antrum, in not one could the tubercle bacillus be isolated. In seven tuberculous individuals (not pulmonary) no changes were present in either the maxillary or frontal sinuses demonstrating clearly that no direct connection exists between tuberculosis and sinus disease.

As a further test in this direction, my assistant, Dr. H. M. Goddard, employed the following technic in five cases. The nares on both sides were thoroughly flushed out and the Lichtwitz needle introduced under strict antiseptic precautions. A small quantity of sterile normal salt solution was injected into the antrum; then aspiration was practiced. The fluid thus obtained was caught in a sterile vessel and incubated. Various cultures were attempted, but in no instance were microorganisms present.

To revert now to our question, it would seem that the difference between the clinical and post-mortem findings depends largely on the length of time which has elapsed between the necropsy and the death of the patient. The longer the time the greater the probability of finding secretion. This would account for the variance in the results of the previously mentioned pathologists which appear in the following order:

1. Harke, sinus disease in 60 per cent.; post mortem.
2. E. Fränkel, sinus disease in 35 per cent.; post mortem.
3. Wertheim, sinus disease in 29 per cent.; post mortem.
4. Minder, sinus disease in 23 per cent.; post mortem.
5. Törne, sinus disease in 23 per cent.; post mortem.
6. Skillern, sinus disease in 11 per cent; intra vitam.

The pathologic explanation of this discrepancy appears to be due to the action of the cilia. It is entirely within the range of possibility that during the last days of a consumptive, owing to the debilitating character of the disease, the action of the cilia becomes feebler and feebler until the ciliary wave is so weak that it is unable to expel the secretions from the cavity. This would explain the post-mortem conditions found several hours after death. We must, however, admit that sinus disease in tuberculous patients is far less prevalent than post-mortem examination would lead us to suppose. This fact was clearly brought out and substantiated by the results of the exploratory needle punctures.

CONCLUSIONS

1. The sinuses in health are free from bacteria.
2. Tuberculous subjects are not more prone to sinus inflammation than are other individuals.
3. Tuberculosis of the lungs does not predispose to sinus inflammation.
4. Genuine tuberculous processes are rarely if ever found isolated within a sinus.

2032 Chestnut Street.

5. Törne: Studien über die bakteriellen Verhaltnisse der Nasennebenhöhlen, Nord. med. Ark., 1904, I.

ABSTRACT OF DISCUSSION

DR. JUSTUS MATTHEWS, Rochester, Minn.: I have found suppuration of the antrum possible without the constant presence of demonstrable pus, and I think that fact offers a possibility of error in Dr. Skillern's conclusions.

DR. L. W. DEAN, Iowa City: I have seen two cases of alveolar necrosis in which exploratory puncture of the antrum was negative although it contained pus. One of the patients was operated on in the public clinic and the statement was made

after puncture that the antrum was not involved, and it was somewhat embarrassing to find on operation that the antrum was filled with polypi, although there was no purulent secretion present.

DR. HANAU W. LOEB, St. Louis: While these experiments are certainly very interesting they hardly justify completely the conclusions of Dr. Skillern. It is quite possible that there might be disease of the sinus without a sufficient amount of exudate to show in the washings. I do not think Dr. Skillern has done enough as yet to justify the theory that inflammation results from the fact that the cilia lose their function during the last few days of life. Examinations made immediately before death might show whether this conclusion is correct or not.

DR. W. C. BALLENGER, Chicago: Dr. Evans, of Chicago, who was pathologist at the Cook County Hospital several years ago, made some observations along this line as to exudate in the crypts of the tonsil; he found that a large percentage of these cases showed the presence of diseased exudate in the sinuses and crypts of the tonsils and his conclusion was that just previous to death the vitality of the individual became so low that there developed in these cavities an inflammatory condition that had not existed a few days earlier. It is quite possible that these examinations might have been made just at the time when there was no demonstrable pus; that we might have a diseased sinus without the presence of demonstrable pus, at least by the methods pursued by Dr. Skillern. While the observations of Dr. Skillern are interesting yet they would have been more valuable if he had had *x*-ray pictures to show if there was any inflammatory process in the antrum. I do not agree with Dr. Skillern in his statement that the antrum is more often diseased than any other sinus; I believe that the ethmoid sinuses are much more frequently involved than any other.

DR. ROSS H. SKILLERN, Philadelphia: That needle puncture might be negative and yet disease of the antrum exist, is, of course, unquestionable; but I was not looking for changes in the mucosa, but rather for exudate in the cavity. I investigated the matter after the findings of the men I quoted, particularly Minder, who speaks of an exudate being present. If it were present, it would have to come out with the needle puncture as employed. Examinations, microscopically and by culture, were made, and even these failed to disclose inflammatory products. *X*-ray and post-mortem examinations would have been desirable, but were not available under the circumstances.

USE OF SALVARSAN IN LESIONS OF THE NOSE AND THROAT

C. R. C. BORDEN, M.D.
BOSTON

Of all syphilitic lesions, those of the nose and throat yield most rapid and satisfactory results. Unlike the other specific lesions, the stage of the disease apparently is of little or no consequence. The tertiary symptoms give way to the magic of salvarsan as quickly as do those of the primary and secondary stages. Bone lesions of the roof of the mouth and of the nose recover nearly as rapidly as do those of the mucous membranes and muscles of the throat. One structure alone in our field of work resists the treatment for any length of time. Specific lesions of the larynx for some reason or other do not react to the treatment with the same degree of satisfaction as do those of the nose and oropharynx.

Early syphilitic lesions often find their way to the specialists in nose and throat diseases and tertiary lesions are often seen in our special field of work. Thus we are frequently called on to treat the ravages of this dreaded disease. Were nose and throat lesions our only consideration, the task would be an easy one. It frequently becomes necessary, however, to assume the entire responsibility of the patients' misfortune and in that capacity we are called on to diagnose and treat any specific lesion in the entire body. To combat the disease successfully in our own field of work, we must thoroughly understand the action of this new and not altogether harmless drug on every other organ of the body; particularly as certain structures are highly susceptible to its irritating influences.

Generally speaking, salvarsan is indicated in diseased conditions of the body when a positive Wassermann reaction is present. Occasionally this diagnostic reaction may be negative. Should experience in syphilitic disease lead us to suspect the lesion to be specific and a careful systematic exclusion of other causes still points toward syphilis as a probable cause, salvarsan is still indicated and in many cases will speedily give the desired result. Experience has taught the profession, however, that there are certain limitations to this mode of treatment which must be clearly understood and rigorously observed lest harm come to the patient.

Broadly speaking, salvarsan is contra-indicated in any acute inflammation of the eye, heart, kidney or nervous system. To use salvarsan in an acute inflammation of any of these organs may mean danger or even death to the patient. There is again an exception to this rule, however. Whenever active inflammations in these organs are of specific origin, salvarsan is not only indicated, but demanded for the welfare of the patient.

More than one death has occurred in Boston from the giving of salvarsan and severe inflammation of important organs has followed its use, to my certain knowledge. Certain individuals show a marked idiosyncrasy to arsenic, and in such instances average doses of salvarsan may give rise to very disagreeable symptoms. One such case occurred in a woman from a comparatively small dose and continued for a considerable length of time with highly disagreeable symptoms. One Boston physician, if he has any reason to suspect such a tendency in his patients, tries them out for a few days on Fowler's solution. In the early days of salvarsan treatment, much was written about arsenical poisoning, due no doubt to an impure preparation of the drug, or to a faulty solution of it. At present, this particular phase of the treatment causes comparatively little trouble, even when very large doses are given. So much has been written on the method of giving salvarsan that little good can come from further discussion. Suffice it to say, that intramuscular injections are almost never given at present.

The choice of location and method of introducing the solution into a vein rests with the operator. The dissection method and the Schreiber method each has its advocates and it makes little difference to the patient which is used, providing the solution reaches the bloodstream and no leakage occurs. The Schreiber method is open to this objection that a very sore arm will result in the case of any fluid leaking into the surrounding tissues. The dissection method is oftenest used for this reason, and it practically does away with such a possibility.

Both methods have been in use in the Boston City Hospital since the beginning of salvarsan treatment and are equally successful in their results.

Two equally distinct systems are used also in the amount of the drug given. One system uses comparatively small doses repeated at intervals. The other gives one large dose not repeated. The first system in addition employs iodids and mercury as a routine treatment in conjunction with salvarsan. The other relies

on salvarsan alone and gives neither iodids, mercury or other antisyphilitic medication. In the case of the combined treatment, the dose varies with the age, size and strength of the patient, stage of the disease, etc. From 0.4 to 0.6 gm. constitutes the dose in this system followed at once by mercury and iodids or both, in the ordinary doses. In the other method. 0.9 gm. is given in one dose and is not repeated for three months. As before stated, this method is not followed by iodids or mercury. Equal results are claimed for both methods so far as clearing up of symptoms is concerned. Just what the comparative results are in obtaining negative Wassermann reactions I am unable to state. In the first method, the operator prefers giving mercury by inunction first, deep injection second and by the mouth last of all. When eye symptoms are present the succinimid of mercury is chosen, the great advantage claimed for this drug being its free solubility.

All primary and secondary symptoms clear up like magic under treatment with either system, and tertiary lesions yield to it in an almost equally spectacular manner. Tertiary bone lesions in a state of inflammation are usually very rapid in their recovery, as are also any broken-down tissues in this stage of the disease. The deeper the spirochetes are in the tissues, the less rapid and effective is the treatment by salvarsan. The greater the blood-supply of diseased tissue, the more rapid and effective is this treatment. This is undoubtedly the reason that nose, throat and eye symptoms are so rapid in their recovery. This is doubtless also the reason why broken-down tissue in the tertiary stage yields so much better results in the same period than intact lesions such as gummata. Here again is the theory advanced for the use of iodids.

Tertiary lesions occur most frequently in comparatively dense tissue, and the process of this stage is more or less to wall off the lesions from adjacent structures This walling-off process, as in the case of gummata, decreases the blood supply to a marked extent. In this process the salvarsan in the blood stream has far less ability to reach the spirochetes, and thus to exert its antisyphilitic power on them.

Iodid of potassium has the peculiar power of breaking up this walling-off process, peculiar to the tertiary stage and accomplishes a great amount of good by establishing free access to the tissues for the blood to enter. Neither salvarsan nor mercury possesses this ability, peculiar to the iodids. Mercury and iodids or salvarsan and iodids, work hand in hand in this respect, however, as the mercury and salvarsan rush in to kill the spirochetes as soon as the iodids have broken down the wall of resistance to their antisyphilitic powers. Personally, I believe that the iodids play a most important rôle in this respect. It is claimed that salvarsan ceases to have any potency after five days have elapsed. If this is true, mercury in conjunction with the iodids is an important factor in clearing up the spirochetes left unharmed by the salvarsan.

The sudden breaking down of walled-off cavities containing large numbers of spirochetes occasionally gives rise to a curious phenomenon. Great numbers of spirochetes are then released in the tissue in too great numbers to be overcome and killed by the salvarsan, or the potency of the drug is too feeble to destroy them. When such an occurrence takes place, a local inflammation begins in that locality, and the lesion in that particular part becomes exaggerated and more active.

Shortly after salvarsan has been introduced into a vein certain symptoms may develop, which are somewhat disagreeable to the patient. A sensation of fulness in the head or vertigo often occurs; headache, nausea and an occasional rise of temperature and chills may follow. The headache occasionally is severe enough to require an opiate of some kind. Usually, however, all such symptoms last but a few hours and are of comparatively little consequence. In two cases, of which I know, extreme hysteria occurred and persisted for two days.

Elevated temperature is most apt to arise in early secondary symptoms with extensive rash present. It occurred, however, in one of our hospital cases in a tertiary lesion of the larynx. In this case it rose to 102.8 F. after the first injection, to 102.2 F after the second, and to 100 F. after a third. Except for the comfort of the patient, little or no attention need be given this phase of the treatment.

Untoward symptoms have occurred in the city of Boston in a very small percentage of cases, so far as I can learn. I have heard of two deaths following the use of this drug. Very sore arms were encountered in the early days of the treatment, but rarely occur at the present time. Arsenic poisoning has occurred several times with its attending symptoms. Other than this I have heard of no harmful results. At least five or six hundred cases have been reported by Boston writers, which brings the percentage of fatal or complicated cases down to a very small figure

In the early days of salvarsan treatment, great stress was laid on the danger of blindness following its use. Three factors entered largely into the reason for this: (1) Other forms of arsenic than true salvarsan were used in experimenting; (2) the salvarsan used was not properly prepared; (3) experiments were performed largely on small animals whose eyes are very susceptible to irritation from arsenic. This is particularly true of cats. Latter day treatment with salvarsan has given little trouble in the eye, and except in optic inflammation of a non-specific origin, the eye is not particularly subject to inflammation. In syphilitic diseases of the eye, such as iritis and interstitial keratitis, brilliant results have followed its use. In one case of chorioiditis, in the Boston City Hospital, the treatment failed to give relief. The question may be raised, however, as to whether or not this particular case was of syphilitic origin. It is only fair to state also that in one case salvarsan caused decided harm; panophthalmitis developed, which cost the patient the loss of an eye. In this particular case, salvarsan undoubtedly made the eye worse and was responsible for its loss. One or more of the eye cases deriving marked benefit from the treatment were patients with congenital syphilis.

Aural complications following the treatment are rare. Two cases have occurred to my certain knowledge, however. One of them occurred in my private practice. Both occurred in tertiary cases and developed soon after injections of salvarsan. My own case was peculiar in that it followed the third injection, having had no trouble in that respect following the first two injections. Both patients had tinnitus and fulness in one ear only, accompanied by a certain amount of decreased hearing in the one ear. Both cases cleared up after a few weeks, and the patients had no further trouble in that respect.

I wish to call attention to headache, especially of the nocturnal variety. Several cases have come to my attention, accompanied by this symptom, which have yielded to salvarsan treatment, when everything else failed. When this distressing symptom fails to respond to treatment, this method of treatment should be

seriously considered, even if a Wassermann test is negative. A number of such individuals have obtained the most blessed relief in this manner, and as a last resort, salvarsan often gives the desired result. The same may be said of the pains of tabes in many instances.

CASE REPORTS

The following cases are interesting and illustrate very well certain phases and characteristics of salvarsan treatment:

CASE 1.—This case, which is claimed to be the most spectacular salvarsan recovery known in Boston, occurred in the service of Dr. Cunningham, at the Long Island Hospital. The infection was undoubtedly of Asiatic origin and physicians who have seen cases in all parts of the world have pronounced this particular case to be the worst one they had ever seen. The patient, a young married woman, developed the rupial type of the disease and after a time showed the blebs practically over the entire body. At this time she presented a horrible spectacle. Salvarsan was given and, a few weeks later, the lesions entirely cleared up, except three scars the size of a ten-cent piece, and a small loss of tissue of one of the alæ of the nose.

CASE 2.—A. J., male, chauffeur by occupation, entered the hospital because of dyspnea. Examination showed the cords to be closely approximated and considerable swelling of the arytenoids and epiglottis was present. Tracheotomy was necessary and was performed. Three injections of salvarsan were given at intervals. After each injection the temperature was raised for a short time and also after each injection the patient coughed up a black material which appeared to be from an abscess cavity somewhere in the larynx. Considerable relief apparently followed each injection. After several months' treatment the patient was able to get about the ward without the tracheotomy tube, but occasionally the abductor paralysis returned temporarily and the tube had to be reinserted.

CASE 3.—This case illustrates the uncertainty of salvarsan, when the treatment is neglected.

A. O., aged 20, male, entered the hospital for specific disease of the nose. There was necrosis of the septum and of the nasal bones and the odor was so bad that patients refused to remain in the ward with him. Salvarsan was given and in a month's time all the necrosis, crusting, odor, etc., had entirely cleared up. He was discharged from the hospital with instructions to return in thirty days for further treatment. He did not return for five months and when seen again was in practically the same condition as before. Salvarsan was again given and the symptoms entirely disappeared for the second time.

CASE 4.—The fourth case was very spectacular, particularly in the early history. Mrs. S. came to my office July 7, 1911. She complained of an intense headache, which had persisted for a long time. The pain was mostly on the top of the head and was worse on stooping. There was also a gnawing pain over the nasal bones. Examination showed the cartilaginous septum to be entirely gone; the vomer and turbinates were intensely red, covered with crusts and bled freely on the slightest touch. July 11 a Wassermann test was made and found positive. The following day salvarsan was given by Dr. Sanborn. Twenty-four hours after the treatment was given the headache and gnawing pain ceased. Within the next four days there was a sharp line of demarcation between the living and dead bone. The necrosed bone separated easily and was picked out of the nose with a small pair of forceps. Eventually the entire nasal septum came away, but the nasal bones and the turbinates were unharmed. The crusting decreased to a very considerable extent within the next few weeks and the odor practically disappeared. The headache has given little discomfort since. The patient has had three injections of salvarsan and has taken mercury off and on. She does not tolerate mercury well and cannot use inunctions at all. After the third injection this patient developed aural symptoms, consisting of fulness, tinnitus and decreased hearing; all in one ear only. This lasted for several weeks and gradually disappeared. We have never been able to get a negative Wassermann reaction in this case, but the woman is under observation still.

Innumerable cases might be given of nose and throat symptoms which cleared up under this treatment. In one case of leukoplakia, seen and treated in the hospital by Dr. Binney, the patient improved very much, but was not, at the time of the last note, entirely well.

There seems to be a strong feeling in Boston that salvarsan should not be given with an acute inflammation of the larynx present. Just why I have never been able to learn. One case particularly was cited against the procedure in which a hurried tracheotomy was necessary. It so happened, however, that in this much quoted case the tracheotomy was done before the salvarsan was given. This patient had a laryngeal growth of some kind, and had been unable to lie down for some time. When the patient was placed in the recumbent position, just previous to a salvarsan injection, the growth in some way obstructed the larynx and a tracheotomy was necessary at once. False rumors of this case went abroad, and from them grew the theory that salvarsan should never be used in laryngeal cases.

What the future will prove as to the numbers of cures is a matter of speculation only. No man can tell. Cases have been reported of the reinfection of syphilis, after salvarsan treatment. One such case occurred at the Long Island Hospital, after Dr. Cunningham's treatment, in which a man had a typical hunterian chancre. Such instances are rare, however, and a recurrence of symptoms in the same case is not uncommon. In a great many cases it has been impossible to obtain a negative Wassermann test. When such negative tests are obtained it is impossible to know whether or not they will remain so for the rest of the patient's life. We do know, however, that in the vast majority of cases, salvarsan will cure symptoms like magic, and that if the first dose fails, others may be given at proper intervals, until the symptoms are conquered and disappear.

No syphilitic lesions will have been well treated until salvarsan shall have been administered in scientific doses, and repeated at proper intervals as long as the lesions persist.

Experience is teaching us, however, that in many cases, salvarsan alone is not sufficient. Our old friends, mercury and iodids, are still necessary to accomplish the results we desire in syphilitic disease, and they are still valuable agents to be used in conjunction with the brilliant but somewhat unreliable salvarsan.

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ABSTRACT OF DISCUSSION

DR. GEORGE P. SANBORN, Boston: During the past year and a half I have used salvarsan in the treatment of more than 200 cases of syphilis. Among the interesting topics which suggest themselves is the question of how much confidence to place in salvarsan alone, without the aid of mercury and potassium iodid. That a single dose of 0.5 or 0.6 gm. cannot be depended on to extinguish the disease became evident when one of my earliest patients developed an iritis two months after the secondary rash and mucous patches had disappeared following 0.5 gm. salvarsan. Other early experiences also led to the same conclusion. It was perfectly evident that some of the spirochetes had continued to exist in spite of the treatment. Since almost the first, therefore, I have used mercury and potassium iodid as the most conservative treatment to supplement salvarsan.

In the very early stages of the chancre the infection approximates a local one. Just before the rash develops and later, the

condition becomes a septicemia, the spirochetes become generally distributed throughout the tissues. The chances of destroying all the microorganisms are obviously much greater in the first than in the second case. Hence the importance of early diagnosis and intensive treatment at the time when the conditions are most favorable. At this time absolute cure is apparently attainable. Intensive treatment means in most cases two doses of salvarsan, ten days apart, followed by mercury salicylate ½ to 1½ grains every six days for three or more months. Mercury should be continued after the Wassermann reaction is negative.

I hope the time will come when the syphilitic can be isolated during the most infectious stages. Until such ideal conditions come about, it is incumbent on the hospitals to eliminate so far as possible these individual foci of infection, by offering each and every actively infectious syphilitic vigorous treatment with salvarsan and mercury. I cannot emphasize too strongly this feature of salvarsan, namely, that in a very few days the recipient, even though previously at the height of his infectiousness, becomes practically non-infectious and of little danger to the community. Extensive, intelligent use of salvarsan cannot help but lessen the incidence of syphilis. Of the various methods of administering salvarsan, the Schreiber seems to me the best. Experience in inserting the needle into a vein is soon obtained, so that incision to lay bare the vein will be necessary only when the veins are small or deeply situated, or both.

DR. WOLFF FREUDENTHAL, New York: I have treated twenty or more cases and have had about the same result as other men. One point which has not been brought out in Dr. Borden's paper is the question of whether we should inject salvarsan in tuberculous patients. I had two remarkable experiences: one, a patient sent to me from Philadelphia who had received one injection of salvarsan which was followed by a large ulceration in the pharynx and larynx which nothing could check. Finally, the patient could take no food at all. We examined his lungs and found incipient tuberculosis. The patient soon died. In another case I had the opposite experience. On the basis of this first case I advised my patient not to have salvarsan injected, but in spite of that he received it and it was remarkable how his symptoms improved.

DR. J. H. ABRAHAM, New York: I had two cases of gumma of the septum, one of which was under treatment two months; the patient had been advised to have an operation for the obstruction. There was necrosis and almost complete occlusion to breathing. He was injected with salvarsan, and on the fifth day it was impossible to see any vestige of the diseased condition in the nose. The second injection was given on the sixth day and the third at the end of the third week, at the end of which time the Wassermann was negative. While abroad last year I met Professor Ehrlich, who introduced me to several physicians who administer salvarsan in hospitals in Frankfort. They prefer inserting the needle with the point directed upward.

DR. GEORGE L. RICHARDS, Fall River, Mass.: Has any one seen any cases of facial paralysis following the use of salvarsan? I translated Professor Alexander's report of some cases last year in which this had occurred. Some cases also occurred in Kaufman's clinic in Vienna. I should like to know if any have occurred in this country.

DR. H. W. LOEB, St. Louis: I had a case of evident labyrinthine trouble which followed the administration of salvarsan. The patient had an initial lesion; spirochetes were found in the lesion, which was excised, and salvarsan was administered two days after the patient first noticed the sore. There were no immediate untoward symptoms, but three weeks later the patient was suddenly taken with nausea, vomiting and dizziness and was put to bed. I saw him sometime afterward when the vomiting had ceased and the nausea was practically gone, but found he had spontaneous nystagmus toward the side of complete deafness, the right side. This was elicited only when he looked toward the affected side. His spontaneous nystagmus continued six months, but now is hardly perceptible. His deafness has not improved. The man's labyrinth now reacts normally. During the time of the nystagmus the test with the finger movements was normal. There was no ear trouble whatever before the injection. Some have thought that the ear symptoms following salvarsan were due to the disease rather than to the injections. Since the time of the initial lesion the patient has had no symptoms of syphilis.

DR. DUNBAR ROY, Atlanta, Ga.: A medical student who contracted syphilis last fall, followed by secondary eruption, was given salvarsan; no symptoms were produced in the ear. All the rash disappeared and the general symptoms improved. Two weeks later the patient began to have tinnitus and loss of hearing. That was in November; in February I saw him and made further tests. While I could not see that any of the indications were labyrinthine definitely, I considered it a nerve deafness, and now he is totally deaf in both ears. A physician in Atlanta has used the new preparation in a hundred cases and finds it better in every respect. He says that many of the toxic symptoms that occurred with the old preparation do not occur with this neutral preparation.

DR. EMIL MAYER, New York: The statement has been made that specific lesions of the larynx do not yield so readily as those of the nose and throat. I should take exception to that from my experience and judging from the experience of those who have seen a great deal of these conditions. I might say in this connection that I think there is hardly a person present in the room who has seen such a number of cases of serious syphilitic lesions in our own country as is seen abroad. I should like to know how many men there are who have had patients coming to them year in and year out for the introduction of bougies to distend cicatrices of the pharynx. In my experience of twenty-five years in New York, where I have seen perhaps 50,000 cases, I recall but one single case in which it was necessary to use divulsive methods. On the other hand, in Berlin and Vienna, we see many patients with extensive lesions in the pharynx and larynx. When we hear men like Chiari and Onodi relate their experiences with salvarsan and state how the lesions of the larynx disappear like snow under the summer sun, we must believe them, and with the few cases we have seen we feel that their statements are justified.

DR. C. R. C. BORDEN, Boston: In answer to Dr. Mayer, I did not mean to say that inflammations of the larynx did not yield to salvarsan, but they do not yield, in my experience, with the same rapidity as do lesions of the nose, mouth and upper pharynx; neither do they remain cured as the others do. There is now in the hospital a case of paralysis, the cords being closely approximated, and a tracheotomy was necessary at once. A Wassermann test was strongly positive and salvarsan was given immediately. The next day the patient, in a severe paroxysm of coughing, coughed up a black material. This patient has had three injections of salvarsan, four weeks apart, and after each has coughed up this same black material. He has been in the hospital now four months and has had three injections of salvarsan, potassium iodid and mercury. He is now able to walk about the ward without the tube, but if he becomes excited in any way the tube has to be reinserted. There is a strong opinion in Boston that injections of salvarsan cause edema of the larynx. This idea came from a case in which it was said tracheotomy had to be done immediately after the use of salvarsan. As a matter of fact, this patient had an intralaryngeal growth, and he had been unable to lie down for several months. When he was placed in a recumbent position, in order to administer the salvarsan, the growth suddenly obstructed the larynx, and a hurried tracheotomy was necessary before the salvarsan was injected. We have had several larynx cases in the hospital, and in all of them the results have been slow.

The syphilis we see in this country is not the same as that seen abroad. What is said to be the worst case that ever occurred in Boston was of Asiatic origin. Several medical army officers and physicians with European experience pronounced it to be the worst case they had ever seen: yet one injection of salvarsan cleared up all symptoms in a few weeks.

Intramuscular injections I still maintain are very little used at the present time, because of the disagreeable and dangerous symptoms which follow their use. Compared with the intravenous method the results obtained have been almost uniformly unsatisfactory.

In answer to Dr. Richards, I know of no case of facial paralysis following the use of salvarsan.

CELLULAR CHANGES DURING AND AFTER ACUTE MASTOIDITIS WITH A CONSIDERATION OF THE INADVISABILITY OF CERTAIN OPERATIVE PROCEDURES AT PRESENT LARGELY IN VOGUE

E. R. LEWIS, M.D.
DUBUQUE, IOWA

I was prompted to present this paper by an informal discussion of the subject with a fellow member of this Section, during which discussion it developed that there existed between us a wide difference of opinion in regard to certain surgical fundamentals involved. My own observations have convinced me that the number of operators who do not hold views similar to mine is not small, and this opportunity is sought for a comprehensive discussion of the subject. It is to be hoped that none of the Section's time will be taken up with discussions of unimportant differences in technic or of procedures applicable to unusual departures from type, which in no way form any part of the subject. I appreciate that certain individual cases are laws unto themselves and present conditions which cannot be foreseen; exceptional virulence of infection, unusual lack of resistance on the part of the patient, in short, anything which has a *"sui generis* all its own," as a western writer once expressed it, may be adduced in valid argument against some portion of the contents of this paper, which deals only with general principles underlying the surgery of acute purulent mastoiditis.

It was my intention originally to make the pathologic findings during and after acute inflammation the basis of a study of the questions involved, but physical incapacitation at the time projected for this part of the work, and discovery of some authoritative statements regarding these pathologic findings determined the presentation of the subject without pathologic material.

My propositions are briefly the following: In operative treatment of an acute purulent inflammation of the tympanomastoid structures, any procedure having for its object aught than relief of pressure and establishing drainage is a surgical error. The antrum should not be opened in the absence of special indications for so doing, and should never be curetted under any circumstances.

The mucoperiosteum of the tympanic cavities, unlike its continuation in the eustachian tube, contains almost no glands, only a few scattered ones being found on the floor, the inferior portion of the outer wall, and the outer part of the superior wall of the cavum (von Tröltsch and Bulle). The epithelium is ciliated cylindric in type only over small areas. That covering the membrana tympani, the ossicles, promontorium, attic and pneumatic spaces of the mastoid is pavement epithelium (Jacobson and Blau, and Kölliker). Transitional cell zones delimit the latter areas. Kessel describes minutely stomata in the pavement epithelium of tympanum and antrum communicating directly with underlying lymph-channels, and calls attention to the enormous absorptive powers of this structure, as does Bezold, who adds a comment relative to the equally great power of recuperation after violent inflammation and enormous swelling incidental thereto, thickening of 10 to 12 mm. having been observed in membrane normally 0.02 mm. thick, with subsequent absorption of all inflammatory exudate and complete subsidence of swelling.

Mucous secretion has its origin in two sources, the glands and the epithelium. Siebenmann failed to find the glands reported by certain authors and takes issue with them as to the existence of any glands at all. Schwalbe, Blau and others remark the possibility of the existence of moderate accumulations of secretion on the floor before eustachian tubal drainage can begin. It seems certain that to cause the outflow via the eustachian tube of accumulated secretion is not the sole function of the cilia.

The pneumatic spaces of the mastoid process and the aditus are dependent almost entirely on the pavement epithelium to remove secretion. In the tympanum a considerable part of the secretion is removed through absorption by the lymph-streams via stomata in the pavement epithelium, ciliary action being concerned in urging onward the masses of secretion toward the tube and toward the pavement-epitheliated absorption areas. The mucoperiosteum of the aditus, antrum and pneumatic cells of the mastoid bears non-ciliated pavement epithelium, and its blood-supply is concerned in nourishing the mucosa on the one hand, and the underlying bone on the other. Where it covers non-diploetic bone it constitutes the sole source of nourishment to the bone; diploetic bone receives additional nourishment from the circulation of the diploetic vascular system. Diploe is found in the temporal bone in widely varying distribution; Zuckerkandl, Zoja, Schwartze and others have examined many hundreds of temporal bones with a view to ascertaining facts relative to the presence of diploe; the consensus of these findings indicates that in about 40 per cent. the pars mastoidea contains no diploe; in about 22 per cent. it is entirely diploetic, and in about 38 per cent. it is mixed, pneumatic-diploetic. Diploe is normally absent from three sites in the temporal bone, the promontorium, the prominence of the horizontal semicircular canal, and the internal auditory meatus (Neumann).

After acute destructive processes involving the periosteum alone, or the periosteum and underlying cortex, diploetic bone undergoes rapid repair, granulations nourished by new-formed vessels from the diploetic circulation springing up and covering the site of the destructive process very rapidly; non-diploetic bone, on the contrary, undergoes repair very slowly, for the reason that it is entirely dependent on one vascular supply, that of the periosteum, which has been involved in the disease process and hence is not so well able to respond to the call for new vessels and nourishment.

Now consider briefly the steps in common to all acute purulent inflammations in the pars mastoidea, the avenue of infection of which is the tube and tympanum. Acute purulent infection of the cavum tympanicum, epitympanum and aditus causes acute inflammation of the mucoperiosteum, which swells enormously; the eustachian tube is closed and there is purulent matter under pressure in tympanum, attic and antrum. In writing of pus enclosed in the cavities of the middle ear under pressure, Körner says:

> **The earlier this pressure is relieved and the freer the drainage, the better the prognosis for cure without bone-destruction. The later pressure is relieved and the less adequate the drainage, the oftener the bone and mucoperiosteum will partake in the destructive process. In case of inadequate drainage, the thin bony walls will suffer synchronous attack of the destructive process from both sides. By swelling of the mucoperiosteum the small mouths of the tubes are easily closed off from the antrum, thus setting up a purulent process apart in such cells, while antrum and cavum tympani may undergo complete healing.**

The previously existent cavities of the tympanum and mastoid are completely filled by swollen mucoperiosteum, the circulation of which is so interfered with by counter-pressure of the non-yielding bony walls, within which is found insufficient space for swelling, as to result in back-pressure and consequent epimembranous and subperiosteal serum extravasation. The infecting organisms multiply rapidly under such circumstances and under the influence of their life-products on the tissues decalcification and peptonization begin in the bone.

Up to this point the pathologic changes described are common to non-diploetic, diploetic and mixed pneumatic and diploetic types of mastoid process. In the non-diploetic mastoid process the first bony tissues to suffer are the thin walls of pneumatic cells, which are solely dependent on the periosteal circulation for nourishment and protection. Deprived of this, they undergo rapid destruction, and abscess formation occurs. The abscess enlarges in all directions until some portion of bone is encountered possessed of sufficient resistance to withstand the action of the infectious products. Such resistance can lie only in bone whose circulation is unimpaired —or, in other words, bone not solely dependent for its vascular supply on the infected mucoperiosteum. In such bone, response to the call on the resources of the body for serum and phagocytic protection is prompt; serum protectives in excess flush the part, cohorts of phagocytes assemble, Nature's ramparts in the shape of delimiting organized exudates are thrown up and the progress of the destructive process in this direction is arrested. Then attempts at repair become evident almost at once in the form of granulation tissue, new-formed vessels extending into the exudate, organization and cell replacement, having their source of nourishment in the unimpaired vascular supply of the bone where the destructive process has been arrested. To repeat, an arrest in the progress of a destructive suppurative process in the mastoid may occur when it reaches bone possessed of an unimpaired vascular supply independent of the mucoperiosteal lining of the pars mastoidea. In the type of mastoid process now under discussion (the non-diploetic) the cortex would be the first bone encountered capable of such resistance. In a mastoid process of this type, abscess formation may proceed from one, or more than one nidus, separate abscesses forming at first, breaking into one another as their centrifugal enlargement goes on. Thus the whole processus mastoideus from zygomatic cells to tip cells may be converted into one or more cavities filled with pus and products of bone destruction. The mucoperiosteum by reason of its vascular content is able to withstand the acute inflammatory attack better than the bone, and it is unusual to find mucoperiosteal sloughing even in the presence of wide-spread destruction of bone. In non-diploetic mastoid processes with very thin or dehiscent cortical areas, it not infrequently occurs that the bone destruction proceeds to the external periosteum before the arresting of the purulent process takes place. In such cases pus under pressure finds its way through the bony cortex and intra- or extracranial subperiosteal abscess results (Bezold's perforating abscess, epimastoid abscess, epidural abscess, perisinus abscess, etc.).

In diploetic mastoid processes containing only one or perhaps two pneumatic spaces, genuine abscess formation does not take place. This type of mastoid process is only very rarely the seat of inflammatory disease of any kind. Acute purulent invasion of such a mastoid results in either one of two radically different pathologic conditions. Ordinarily the bone itself escapes infection, true empyema antri being the condition. When the diploetic bone surrounding the antrum does become affected by the purulent inflammation, acute osteomyelitis of the mastoid process occurs. Acute osteomyelitis is extremely rare in the mastoid process and occurs only in young subjects of low vitality, in whom it is very apt to prove fatal. In spite of radical pathologic differences, differential diagnosis between acute osteomyelitis and abscess is not easily made.

There remains the mixed type of processus mastoideus, partly pneumatic, partly diploetic, constituting about 38 per cent. of all. Of these about three-fourths are pneumatic except for 3 or 4 mm. of diploe at the tip, and about one-fourth are half pneumatic and half diploetic, according to Zuckerkandl, Schwartze, Zoja, Politzer and others.

In the mixed type of mastoid process, purulent inflammation effects the formation of small abscess cavities which may remain discrete or become confluent, at whose margins are found organized exudate and granulation tissue. This is almost the only condition in which granulation tissue is found at operation within the pars mastoidea during the course of acute mastoiditis. Most so-called "granulation tissue" found at operation is not true granulation tissue at all, but intensely inflamed and swollen mucoperiosteum.

Analysis of the sequence of changes during the ordinary course of acute purulent infection of the mastoid process fixes the ultimate responsibility for tissue destruction on structural peculiarities of the affected part: unyielding walls completely enclosing mucoperiosteum which undergoes enormous swelling within inadequate spaces, resulting in almost complete retention of inflammatory products because of occlusion of natural ways by the swollen mucosa—almost complete stagnation of circulation because of increased intramastoid pressure—serum-exudation—infiltration of tissues—decalcification of bone—peptonization of pulp—pus under pressure—absorption of toxic products into general circulation—systemic effects of absorbed toxins.

Unlike the mastoid spaces, the tympanic cavity is equipped with a safety appliance, the membrana tympani. This bulges or ruptures in the presence of increased intratympanic pressure, which obviously can never rise beyond the breaking-point of the membrana tympani. Relief of pressure by sufficiently wide opening of the membrana tympani affects the mucosa of the cavum tympani, aditus and antrum, resulting in rapid subsidence of swelling and increasingly better drainage of these cavities. The Germans say: Every acute middle-ear inflammation manifests a tendency to heal spontaneously in spite of all treatment.[1] It has been remarked by many observers, among whom Jacobson and Blau, Politzer and Neumann may be mentioned, that in many cases of acute abscess of the pars mastoidea no communication exists between the abscess cavity and the antrum; and further, that healing takes place in these cases much more rapidly when the antrum is not opened. Many writers have corroborated the observation of Körner that during the course of acute mastoid abscess formation the antrum and cavum tympani may undergo complete healing as the result of adequate drainage through the membrana tympani.

What general surgical principles apply to the operative treatment of these various conditions? Free drain-

1. Jede akute Mittelohrentzündung zeigt die Tendenz sich spontan aufzuheilen, trotz aller Behandlung.

age of the tympanum, aditus and antrum by means of a large incision in the membrana tympani, kept freely open by reincision as often as necessary, should be regarded as the first and most urgent indication. This cannot be emphasized more strongly than it already has been by those who have spoken with an authority I do not possess, yet again and again in my practice I have encountered cases of acute tympanomastoiditis in which actual "puncture" of the membrana has been made. A "puncture" is practically no better than no opening, as it is sure to be closed up almost immediately by the edematous mucosa of the tympanum.

The local depletion of the tympanic mucosa incidental to free incision is a desideratum hardly second to giving exit to retained purulent matter. True empyema antri will need no further surgical procedure in order to secure complete healing as a rule.

Acute mastoid abscess should be opened freely and drained thoroughly as early as possible. Acute osteomyelitis of the processus mastoideus should be laid wide open and treated as an open wound until completely closed from the depths by healthy granulation tissue.

Diagnosis between abscess and acute osteomyelitis may not be made in many cases; it is possible to overlook a cell containing infectious material unless the operator makes a complete exenteration of the processus mastoideus from tip to zygoma via the antrum. Nevertheless I believe that complete exenteration as very widely practiced and advocated to-day, whether by chisel and gouge, burr, rongeur or curet, for any form of acute purulent mastoiditis, is inconsistent with sound surgical principles. I have witnessed many operations for the relief of acute inflammation of the mastoid process at the hands of technically skilled operators who did not cease their operative ministrations until they had encompassed a thorough removal of every visible vestige of intracortical tissue, leaving the exenterated inner cortex from tip to antrum and upward to zygoma as smooth as a billiard-ball, when as a matter of fact their services to the patient for the last thirty to forty-five minutes of the operation were of a nature to increase liability to serious internal ear and intracranial complications, as well as to render healing as difficult as possible rather than to promote it.

In the course of healing after such operative treatment, the cavity must first fill up by granulation. The granulations must have their origin in vascular supply not incapacitated by disease or operation. The inner cortex, denuded of every vessel-bearing tissue, has only a very minute haversian system by which to transmit nourishment from the circulation of its remaining periosteum for the growth of new tissue; the inner antral wall, non-diploetic and bare of mucoperiosteum, is incapable of granulation. These surfaces remain almost as smooth as the operator left them until overspread by extensions of granulation tissue originating at the wound margins, which carry down with them their own source of nourishment and tissue-repair in the form of new-grown vessels, ultimately reaching and covering the antral wall. Then, and not until then, can epithelial extensions from the mucosa of the aditus find foothold in the antrum. During all this process, which consumes weeks, the wound remains open practically to the aditus, while at the wound margins the granulations will have become so exuberant as to necessitate repeated destructions. Not until the antral walls are epithelialized is the wound converted from an antral fistula to a granulating wound filling up from the bottom. From four to eight weeks elapse between operation and final cicatrization. This is not the end, however. Contraction goes on apace in the new-formed cicatricial tissues and ultimately there exists, at the end of the aditus, a "step-off" cavity much larger than the original antrum, not lined with mucoperiosteum, but with an epitheliated cicatricial basement-layer poor in blood- and lymph-vessels, lacking entirely the absorption mechanism peculiar to the endantral periosteomucosa, a cavity poorly drained as compared with its predecessor and, by reason of poorer drainage and lack of high absorptive efficiency and rich vascular supply, peculiarly defenseless in the presence of a reinfection.

Too much stress has been laid on the danger of failing to clean out thoroughly every pocket of pus when operating for relief of acute purulent mastoiditis. In empyema antri this danger practically does not exist at all. In acute osteomyelitis the conservative surgery of open-wound treatment involves allowing the separation of viable from non-viable diseased tissues by necrobiosis or necrosis and the removal of the latter in the form of pus, slough or sequestrum in the natural course of dressing the wound. It is not regarded as possible or desirable, in dealing with acute osteomyelitis, to effect removal of all infected bone at operation, nor is it considered a menace to possible recovery to overlook pockets of pus or areas of infection. Furthermore, no surgical procedure whatsoever can prevent the reinfection of the whole surface of the wound within the twenty-four hours following operation.

In acute abscess of the mastoid process, the prime indications are free drainage and relief of pressure, just as in the case of abscess in any other locality. Failure to clean out pockets of pus during the course of the operation which meets these two indications constitutes no potential danger to the patient, whereas overzealous removal of tissue wide of the abscess cavity limits does constitute very grave potential danger, in that it involves destruction of a safeguard the importance of which to the patient cannot be overestimated, namely, the bulwarks of organized inflammatory exudate which Nature throws up, completely surrounding any such circumscribed purulent infection, obstructing far more effectively than any device of man egress from the septic focus of toxins into the general circulation, and of microorganisms into the neighboring tissues and vessels. The vascular anastomoses between the circulation of the pars mastoidea and that of the meninges and internal ear render extension of infection from an acute mastoid abscess into these danger zones more likely after operation involving the destruction of Nature's barriers than after operation leaving these inviolate.

The second indication, therefore, in the surgical treatment of acute purulent mastoiditis is to make sufficiently wide removal of the outer cortex and intercellular lamellæ to make certain of free drainage and relief of pressure. In a non-diploetic mastoid process, this removal should extend from the uppermost cells downward to the tip and backward to the rearmost cells; in semidiploetic, from the uppermost cells to the inferior and posterior limits of pneumatic cells.

Opening of the antrum should be dependent entirely on the existence of specific indication for such procedure. General indications for opening the antrum are the following:

"1. When bone intervening between abscess cavity and antrum is found by the probe to be softened and mushy.

"2. When the swollen lining of the abscess cavity protrudes directly into the antrum.

"3. When direct communication exists between abscess cavity and antrum.

"4. When, in addition to symptoms of mastoid abscess, symptoms of meningeal irritation are present.

"5. When, after simple opening of abscess cavity, no amelioration of pain in the ear follows, or when symptoms of cerebral nature present suggesting extradural abscess or meningitis.

"6. When in the presence of normal healing after simple opening profuse discharge from the ear persists for several weeks."

Should it be decided to open the antrum, either at first operation or later, the operator should never do more than make free opening into this cavity. The use of the gouge or curet in the antrum is never indicated and should never be made for at least two main reasons, viz:

No matter how badly swollen and inflamed the endantral mucoperiosteum may have been, with the subsidence of the acute inflammation consequent on free drainage, it will return to its former condition with practically no impairment of structure or function, a postoperative result not possible after the curet has been used in the antrum. More important even is the second reason, that the curet traumatizes the bony wall of the vestibule and tegmen, and increases the possibility of the extension of infection to the internal ear and meninges.

1130 Main Street.

ABSTRACT OF DISCUSSION

DR. NORVAL H. PIERCE, Chicago: The idea of the feasibility of opening the antrum instead of entirely cleaning out the mastoid bone to the inner surface is not new. In 1882, Hessler wrote an article in the *Archiv für Ohrenheilkunde*, in which he supported the theory that it is unnecessary to open the antrum or clean out entirely the mastoid cells in the majority of acute cases. As to opening the antrum I agree with Dr. Lewis that it is much better if possible to avoid opening the mastoid antrum and for the reason that he has given. If we take away the outer and posterior walls of the antrum we leave only the inner wall clothed with its mucoperiosteum. The surrounding defenseless bone is very poor in blood-supply and granulation tissue develops relatively slowly from this portion, and a large cavity is left, much larger than the original antrum, that is clothed or nourished by a low grade of mucoperiosteum, which is very liable to repeated inflammations, and the recurring mastoiditis that we so often see, especially in children, is due to this enormous cavity buried in the depths of the wound and the additional invasions following influenza and colds. We cannot gain access to the antrum and drain it and wash out the middle ear without running the risk of the formation of this large poorly nourished cess-pool that occurs from taking away the outer and posterior wall. In a certain number of cases recently I have been able to enter the antrum from below, leaving the outer posterior walls of the antrum, making an opening the size of a pea into the antrum, through which it may be washed out and with it the cavum tympanum. In that way we retain the natural shape of the antrum and do not have that large cavity which occurs from the other way of operating. Regarding the taking away of the osseous structures down to the inner cavity of the skull, we are between the devil and the deep sea.

There is not the slightest doubt but that the vast majority of the patients would do better if we simply took away the outer wall of the mastoid as far as the cells reach, back to the occipital bone, upward to the zygoma, scraping away the softened tissue that probably never would regenerate; but, if we invariably follow this course we are bound to leave certain dangerous foci about the sigmoid sinus; there is no way of avoiding it. To examine the mastoid thoroughly and find out if there are any of these dangerous foci, it is necessary to exenterate the mastoid process; if we want to run the risk of some of these concealed foci remaining, I suppose that 90 per cent. will heal quickly by the simpler method.

DR. CALVIN R. ELWOOD, Menominee, Mich.: It is not a pleasant task, especially for one who does not open the mastoid as often as he should, to keep in best practice to work with chisel and gouge in such close proximity to the cranial cavity, and, if in favorable cases, the desired result can be as safely and surely attained by simply removing the cortex and exposing the superficial cells, without the anxiety which attends the opening of the antrum, it would be fine.

It may be assumed that all are agreed concerning the source of infection—an extension of an infectious process from the middle ear through the aditus to the antrum, and thence to the ramifications of the mastoid cells. The walls of these cells—especially the non-diploetic type—are poorly nourished, being dependent on the mucoperiosteum along which the infectious process may spread by pin-head prolongations to remote cells. This mucoperiosteum becomes greatly swollen and easily falls prey to bacterial action, in which condition it would be logical to suppose it would sufficiently deteriorate to leave the underlying bone without protection or nourishment. Such fragile bony partitions would naturally become necrotic and necessarily be thrown off as sequestra before repair can take place. We cannot tell definitely the condition of the mastoid from observations previous to surgery. We cannot tell at the time of operation the viability of the osseous structure, while experience has taught that dead bone left behind means delayed repair, if not more serious trouble. Therefore, when surgery is necessary why not do it thoroughly? I do not leave the surface as smooth as a "billiard ball" believing as Beck has pointed out, that the burr, probably through heat generated, delays repair. I do, however, endeavor by use of the curet to leave a perfectly clean cavity without a cell unopened, believing that thereby I hasten the healing process both by granulation from the bottom and sides and the periosteum above.

DR. C. F WELTY, San Francisco: So long as we have a method in which we can eliminate all the possible source of infection it seems to me there is absolutely no question left as to the course we should pursue. We may be a little longer in bringing our cases to complete healing, there may be a little more depression, but no such deformity as Dr. Lewis speaks of in his paper have I seen. In about a hundred acute cases, only one patient did not recover and required a radical mastoid afterward. The others recovered without secondary operations. That is a sufficient number to show that there is something worth while in the procedure of going down to hard bone. It is not possible to have such results by being less thorough. Dr. Lewis himself says that, if you have profuse discharge at the end of two weeks, it is better to open the antrum; there you are subjecting the patient to a second operation which should not have been necessary at all. I recall a patient seen in consultation who had been operated on and continued to have a small amount of fever and deep-seated pain. I insisted that there must be some cells that had not been uncovered and when these were eliminated the patient recovered speedily. On three or four occasions I have found cells almost on the inner end of the petrous portion of the temporal bone.

DR. G. F. COTT, Buffalo: When we have a virulent infection due to streptococci or colon bacilli, then I think we must open up freely in every case. When the infection is a mild one and the ear is dry before or at the time of operation, then it is not necessary in any case to open the antrum. When you are sure that you have the cells cleaned out and that no more pus is present, then, instead of packing, close up the wound and heal by blood-clot and the patient can go home in three or four days. If a focus is left it is no trouble to take out the stitches and clean it out. I have had one

patient go home in three days perfectly healed. The result remained good for I observed him for several weeks.

DR. SEYMOUR OPPENHEIMER, New York: What proportion of cases in which the antrum is left intact require reoperation and in what proportion of cases in which closure has been successful has there been a continuation of discharge from the ear? I think the proposition a very retrograde one. Dr. Lewis says that to open the antrum is not surgical; I think just the opposite. I am quite satisfied that a great many cases that require reoperation are cases in which the mastoid antrum has not been opened sufficiently. The mastoid antrum bears the brunt of the burden and if the proposition were placed before me to open the antrum and not do anything else or to leave the antrum unopened and clean out the rest, I should accept the former proposition.

DR. T. R. CHAMBERS, Jersey City: I second what Dr. Oppenheimer has said and enter a protest against the position taken by Dr. Lewis. I am amazed at Dr. Pierce. He knows that in every mastoid operation you should open the antrum. Many times we find a dry antrum and we do not curet, of course, or do a radical operation.

DR. B. A. RANDALL, Philadelphia: The question must depend, I think, a little on the definition of osteomyelitis. Those of us who have seen cases of genuine temporal-bone osteomyelitis, such as reported in this Section by Dr. C. W. Richardson, will never be in doubt about it. It is not true in a clinical sense that because a little of the contents of the diploetic bone is involved, there must be osteomyelitis. The middle ear involves all the pneumatic cavities. The antrum, which so many speak of as mastoid, is the posterior portion of the tympanum and as such is as well able to take care of itself as the tympanum proper or the eustachian tube. As well say you must curet the eustachian tube as to say that you must always curet the antrum and open all the cells. The pneumatic cells may extend clear to the sella turcica in some instances. We must realize that these operative cases offer an infinite variety and we can lay down for the beginner no rule that will make the matter an easy one, so that he can do it as well as the expert who has had a thousand cases or more. If we are to do good surgery we must first decide whether we are dealing with empyema or caries. I hold that empyema of the mastoid can resolve successfully and safely with no bad results, but I do not advise the younger man to trust that. If you are not sure it is better to operate thoroughly; it is safer, but there are many cases that can clear up just as does many an empyema of the antrum of Highmore. When you have caries to deal with, it is a totally different proposition. Tissue which is no longer viable must be taken away. The expert recognizes this by sense of touch with his curet; the beginner who has this yet to learn must risk overdoing a little rather than slight his work.

DR. E. R. LEWIS, Dubuque: I am afraid I have been misunderstood by some; these men will get my ideas more clearly by reading the paper. One speaker alluded to my not opening the antrum, but I say that the man who opens the antrum without specific reason makes a surgical error; and he who, with or without specific reason for opening the antrum, curets its mucoperiosteum, has, without any justification, destroyed what is of enormous importance to the patient, a lymphatic organ which cannot regenerate. I wanted to bring out particularly that the mucoperiosteum is an important organ, possessing functions of great value to the individual, and that unnecessary surgical destruction of any part of it is an unjustifiable procedure. Dr. Oppenheimer asks for something with which I cannot furnish him. I have not a large clinical practice and corps of clinical assistants to tabulate the results of my work. I have been practicing otology for eleven years in a town of 40,000 and have had my share of mastoid work; all the surgery has been based on the principles here set forth. I have not had one patient with an acute case who has been under my care from the outset develop intracranial complication, chronic suppuration, or internal ear disease; and not one of my cases has terminated fatally.

TONSIL DISSECTOR, TONSIL-GRASPING FORCEPS, TONSIL HEMORRHAGE CLAMP

LEE M. HURD, M.D.
NEW YORK

One end of the dissector (Fig. 1) is a retractor for the anterior pillar while applying forceps, and while inspecting the cavity from which the tonsil was removed. The other end is for dissecting out the tonsil. The edge is neither dull nor sharp, but rather an edge that is produced by the use of a fairly rough oilstone, and will cut when given a quick stroke with some pressure and will act as a dull dissector when used without much force.

The forceps (Fig. 2), from the nature of its action, buries itself deeply in the tonsillar tissue under all reasonable conditions. The forceps is laid against the tonsil with the jaws open, one jaw at the inferior end of the tonsil, the other jaw crowded up into the supratonsillar fossa, and then the jaws are pushed into the tonsil as the handle is locked.

Fig. 1.—Dissector.

Fig. 2.—Forceps.

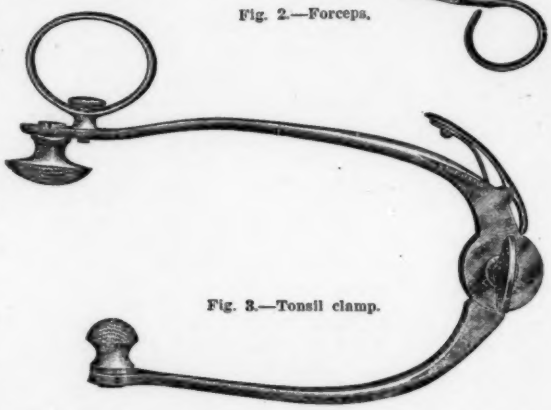

Fig. 3.—Tonsil clamp.

I have used these two instruments for five years. They have never been recorded; but now that the dealers are importing the dissector by the gross (most of which are incorrect models) I feel compelled to offer the instruments.

The tonsil clamp (Fig. 3) is intended for a double purpose; first, as a method to control hemorrhage while removing the second tonsil if the blood from the first one interferes; for this purpose there is a ring fitted to the outside arm through which the assistant can slip his finger and by having the clamp half open exert pressure in the fossa and still be out of the way; second, as a tonsil hemostat clamp to be placed in position and remain for a reasonable time to check prolonged hemorrhage.

15 East Forty-Eighth Street.